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ABSTRACT

During the past 15 years, fluctuations in the prevailing price of oil have had a profound effect on Texas' economic affairs and labor market. Efforts to forecast what the Texas labor market will be like in the future must allow for the diversity among the state's gulf coast, border, plains, eastern, metroplex, and central corridor regions. Different development strategies and distinctive job and skill needs are emerging in each of these regions. Technological, economic, social, and political changes will all affect future labor needs and labor markets in Texas. An analysis of what these changes will likely entail suggests that the greatest number of job openings are likely to occur in the following areas: agriculture/biotechnology/biomedicine, energy, materials science, marine science/aquaculture, aerospace, telecommunications, manufacturing science, and automated manufacturing and office automation. Meeting future vocational, technical, and adult education and training needs requires a strategic planning and development approach that will be flexible enough to respond to changing local needs. Development of community college systems, joint public-private initiatives, technical assistance and consulting services, and a mechanism for instructional planning based on employment data and projections are also important. (Appendixes include discussions of factors influencing the workplace in Texas, important technologies for education and training, and significant sources of unpublished information on future employment in Texas.) (MN)

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THE FUTURE OF THE WORKPLACE IN TEXAS:

A Preliminary Identification of Planning Issues for Technical, Vocational, and Adult Postsecondary Education

a working paper prepared for the

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Texas College and University System
Community Colleges and Technical Institutes Division

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EXECUTIVE SUMMARY

The Coordinating Board approved Part II of the Long-Range Master Plan for Vocational Education in Texas at its October 2, 1986 Board Meeting. The Master Plan is required by law to provide strategic planning directions for technical and vocational education. This working paper was prepared in support of strategic planning activities at the Division of Community Colleges and Technical Institutes, focusing specifically on the feasibility of developing delivery systems based on:

- emerging needs;
- competitive, cost-effective, state-of-the-art training technologies;
- resource funding and implementation via public-private collaboration, rather than by the public sector only.

A workforce that is well-trained in up-to-date skills is an essential ingredient in the economic well-being and competitiveness of the various regions of Texas as well as for the state as a whole. What is the current "state of the state" regarding future regional employment patterns? What types of training would provide the job skills that will be needed? How can the planning of instructional delivery systems provide a better linkage between the two?

Although future employment conditions are not at this time feasible to forecast in great detail, the decade ahead will surely bring:

- **Changes in the types of jobs.** During the decade just past, only an estimated five percent of new jobs were in the manufacturing sector while 90 percent were in the service and information industries. By the end of the century an estimated 5 to 15 million manufacturing jobs nationwide will be restructured as a result of technological and economic factors, with an equal number of service jobs expected to become obsolete.
- **Changes in the nature of work.** New and existing technical jobs will require higher levels of skills, both specialized (how to use a particular technology) and general (basic academic, problem solving and interpersonal skills). It is not so much that such jobs will become "high tech" but that technology will alter how they are performed, with many more **non-technical** jobs being created (which do not require education or technical training beyond high school) than technical jobs.

Technological, economic, social and political factors which may influence the workplace of the future are identified in the report, leading to the view that for the first time in Texas history it may be feasible, as well as essential, for a coalition of professionals in government, education and the business community to create a practical linkage between future employment needs and education to meet those needs.

The report concludes with the presentation of a general process model for collaborative change management and a list of action items which may help the Coordinating Board implement the ambitious goals put forth in its recent Master Plan for Postsecondary Technical, Vocational, and Adult Education.

THE FUTURE OF THE WORKPLACE IN TEXAS:
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The **purpose** of this working paper is to identify, assemble and interpret information on current and emerging trends and issues that will strongly influence the nature of employment--and training for employment--in Texas during the next decade. Of particular priority are issues needed to be understood if Texas is to significantly increase its "market share" of the profitable, but intensely competitive world of high technology.

The **role** of this report is to provide analytical support for planning and management activities conducted and overseen by the Community Colleges and Technical Institutes Division of the Coordinating Board to implement the **Master Plan for Postsecondary Technical, Vocational, and Adult Education**--specifically to include the framing of action items which would significantly increase the feasibility of successfully implementing educational delivery systems based on:

- emerging needs;
- competitive, cost-effective, state-of-the-art training technologies; and
- resource funding and implementation via public-private collaboration, rather than by the public sector only.

Method of Approach

The **focus** of this paper is to provide an exploratory survey of the items listed on Table 1, with "X" referring to "the future of the workplace in Texas." No attempt is made to provide definitive forecasts for all those items however. Preliminary surveys, both of the published literature and of knowledgable professionals throughout the state, indicate that this would be premature at this time.

TABLE 1

ESSENTIAL QUESTIONS FOR THE DEVELOPMENT OF FORESIGHT

1. What is the likely future of X?

2. What is the preferred/feared future of X?

3. What factors will control or strongly influence what happens to X?

4. Who are the people and/or institutions whose behaviors will most strongly influence the future of X ("influentials")?

5. Who has a strong stake in the outcome of X ("stakeholders")?

6. What trends, issues, policies etc. may be emerging that would impact on X, or our ability to influence it ("cross impacts")?

7. Who is most knowledgeable about the above questions ("knowledgeables")?

PROJECTED SHIFTS IN EMPLOYMENT

Overall

Although the dominant types of work in Texas have changed markedly during its 150 year history, none of these changes have been as dramatic as those seen in the last 15 years during which the prevailing price of oil has sent affairs in many parts of the state through a pronounced roller coaster of change.

What will the next decade bring?

Tables 2 and 3 provide a general sense of changes in employment characterizing most of the 20th century, both past and future. Over the next decade and beyond, the workforce of both the nation and the state are expected to undergo a major change in composition, both in the types of jobs and in the nature of work involved.

Tables 4, 5 and 6 typify currently available forecasts on employment. Although they apply to the nation as a whole, their general pattern is expected to typify employment changes in the state as well.

TABLE 2

Employment by Major Industry Group: 1900 to 1995[a]
(percentage distribution)

Industry Group	1900	1930	1960	1980	1995[b]
Agriculture	41	23	8	3	2
Goods-producing					
Mining	2	3	1	1	1
Construction	4	4	5	5	6
Manufacturing	21	24	28	22	18
Services-producing					
Transportation and utilities	9	9	7	6	5
Wholesale and retail trade	10	15	19	22	22
Finance, insur., and real estate	1	4	5	5	6
Services	7	9	12	19	26
Government	4	8	14	17	14

[a]Distributions based on total civilian employment. Nonagricultural employment calculated from data on employees on nonagricultural payrolls, with self-employed and nonpaid family members distributed proportionally among industries.

[b]Data for 1995 based on moderate-trend projections.

Source: Levin, H.M. State Planning for Higher Education and Jobs in an Age of High Technology, 1984; based on U.S. Bureau of the Census, Historical Statistics of the United States, Part 1 (Washington, D.C.: U.S. Government Printing Office, 1975), Tables D1-10 and D127-141; U.S. Council of Economic Advisors, Economic Report of the President (Washington, D.C. U.S. Government Printing Office, 1983), Table B-29; U.S. Department of Labor, Employment and Training Report of the President (Washington, D.C.: U.S. Government Printing Office, 1981), Table C-1; Valerie A. Personick, "The Job Outlook Through 1995: Industry Output and Employment," Monthly Labor Review 106 (November 1983), Table 2.

TABLE 3

Employment by Major Occupation: 1900 to 1995[a]
(percentage distribution)

Occupation Group	1900	1930	1960	1980	1995[b]
Professional and technical	4	7	11	16	17
Managerial	6	7	11	11	10
Clerical	3	9	15	19	19
Sales	5	6	6	6	7
Craft	11	13	13	13	12
Operative	13	16	18	14	12
Laborer	12	11	6	5	5
Service	9	10	12	13	16
Farm	37	21	8	3	2

[a]Distributions for 1900 and 1930 based on experience civilian labor force. Distributions for other years based on total employed persons.

[b] Data for 1995 based on moderate-trend projections.

Source: Levin, H.M. State Planning for Higher Education and Jobs in an Age of High Technology, 1984; Historical Statistics of the United States, Part 1 (Washington, D.C.: U.S. Government Printing Office, 1975), Tables D182-232; U.S. Department of Labor, Employment and Training Report of the President (Washington, D.C. U.S. Government Printing Office, 1979 and 1982), Table A-16 and A-18; George T. Silvestri, John M. Lukasiewicz, and Marcus E. Einstein, "Occupational Employment Projections Through 1995, "Monthly Labor Review 106 (November 1983), Table 1.

TABLE 4

Employment Growth by Major Occupation
1960-90

Major Occupation Group	Employment Growth (percentage distribution) 1960-70 (1)	1970-80 (2)	1978-90 (3)
Professional and technical	30.0	22.3	20.3
Managerial	6.0	22.7	7.7
Sales	5.8	2.6	7.0
Clerical	32.9	21.0	20.0
Crafts	11.2	9.5	12.2
Operatives	7.5	1.8	10.0
Laborers	.7	4.8	4.8
Farm Workers	-14.5	- .2	- 2.6
Service	20.4	15.5	20.7
Total	100.0	100.0	100.0

Source: Levin, H.M. and Rumberger, R.W., Educational Implications of High Technology, 1983; columns (1)-(2) based on Table 2 in Rumberger, R.W., "Growing Imbalance between Education and Work." Phi Delta Kappan, 1983 Column (3) based on Table 2 in Carey, M.L., "Occupational Employment Growth Through 1990", 1981.

TABLE 5

Forty occupations with largest job growth, 1982-95

Occupation	Change in total employment (in thousands)	Percent of total Job Growth	Percent change
Building custodians	779	3.027.5	
Cashiers	744	2.947.4	
Secretaries	719	2.829.5	
General clerks, office	696	2.729.6	
Salesclerks	685	2.723.5	
Nurses, registered	642	2.548.9	
Waiters and waitresses	562	2.233.8	
Teachers, kindergarten and elementary	511	2.037.4	
Truck drivers	425	1.726.5	
Nursing aides and orderlies	423	1.734.8	
Sales representative, technical	386	1.529.3	
Accountants and auditors	344	1.340.2	
Automotive mechanics	324	1.338.3	
Supervisors of blue-collar workers	319	1.226.6	
Kitchen helpers	305	1.235.9	
Guards and doorkeepers	300	1.247.3	
Food preparation and service workers, fast food restaurants	297	1.236.7	
Managers, store	292	1.130.1	
Carpenters	247	1.028.6	
Electrical and electronic technicians	222	.960.7	
Licensed practical nurses	220	.937.1	
Computer systems analysts	217	.885.3	
Electrical engineers	209	.865.3	
Computer programmers	205	.876.9	
Maintenance repairers, general utility	193	.827.8	
Helpers, trades	190	.731.2	
Receptionists	189	.748.8	
Electricians	173	.731.8	
Physicians	163	.734.0	
Clerical supervisors	162	.634.6	
Computer operators	160	.675.8	
Sales representative, nontechnical	160	.627.4	
Lawyers	159	.634.3	
Stock clerks, stockroom and warehouse	156	.618.8	
Typist	155	.615.7	
Delivery and route workers	153	.619.2	
Bookkeepers, hand	152	.615.9	
Cooks, restaurants	149	.642.3	
Bank tellers	142	.630.0	
Cooks, short order, specialty and fast food	141	.6	32.2

Note: Includes only detailed occupations with 1982 employment of 25,000 or more. Data for 1995 are based on moderate-trend projections

Source: Rumberger, R.W. and Levin, H.M. Forecasting the Impact of New Technologies on the Future Job Market, 1984; based on Silvestri, George T., Lukasiewicz, John M, and Einstein, Marcus E. "Occupational Employment Projections Through 1995", 1983.

TABLE 6
EMPLOYMENT IN SELECTED MIDDLE-LEVEL HIGH-TECH OCCUPATIONS
1982-1995

	Employment (In Thousands) 1982	1995	Growth Rate	Job Increase (In Thousands)
Engineering and Science Technicians	1,243	1,661	33.6%	418
Health Technologists and Technicians	627	898	43.2	271
Other Technicians	364	453	24.5	89
Computer Specialists	521	943	81.0	422
Computer Operating Personnel	580	737	27.1	157
Computer Service Technicians	55	108	96.4	53
Engineering Equipment Mechanics	83	94	13.3	11
Instrument Repairers	41	51	24.4	10
Total	3,514	4,945	40.7%	1,431
All Occupations	101,510	127,110	25.2	25,600

Source: Grubb, W.N. Bandwagon Once More: Vocational Preparation for High-Tech Occupations, 1984. Silvestri, George T., Lukasiewicz, John M., and Einstein, Marcus E. "Occupational Employment Projections Through 1995", 1983. The 1995 figures in this table are those assuming a moderate growth rate.

TABLE 7

Potential Displacement from new Technologies

Technology	Occupation Affected	Current Employment (thousands)
Robots	Welders	651
	Painters	130
	Assemblers	1,452
	Other operatives	1,863
	Packers	497
	Laborers	1,000
Automatic teller machines	Bank tellers	516
CAD/CAM	Drafters	335
Debit cards	Cashiers	1,667
Teleshopping	Sales clerks	2,802
Computer diagnostic equipment	Mechanics, repairers	3,578
Office automation	Secretaries, stenographers typists	4,508
	Bookkeepers	1,777

Source: Rumberger, R.W. High-Technology and Job Loss, 1984; Calculated from 1980 Public Use Sample, U.S. Bureau of the Census.

By Region

Adequate information regarding regional employment differences in Texas does not yet exist. Enough is available to visualize current and projected employment and employee skill priorities, however. For this purpose the six economic regions distinguished by the Office of the Texas Comptroller are convenient to use, even though occupational forecasts customarily use labor statistics which are categorized according to metropolitan statistical areas.

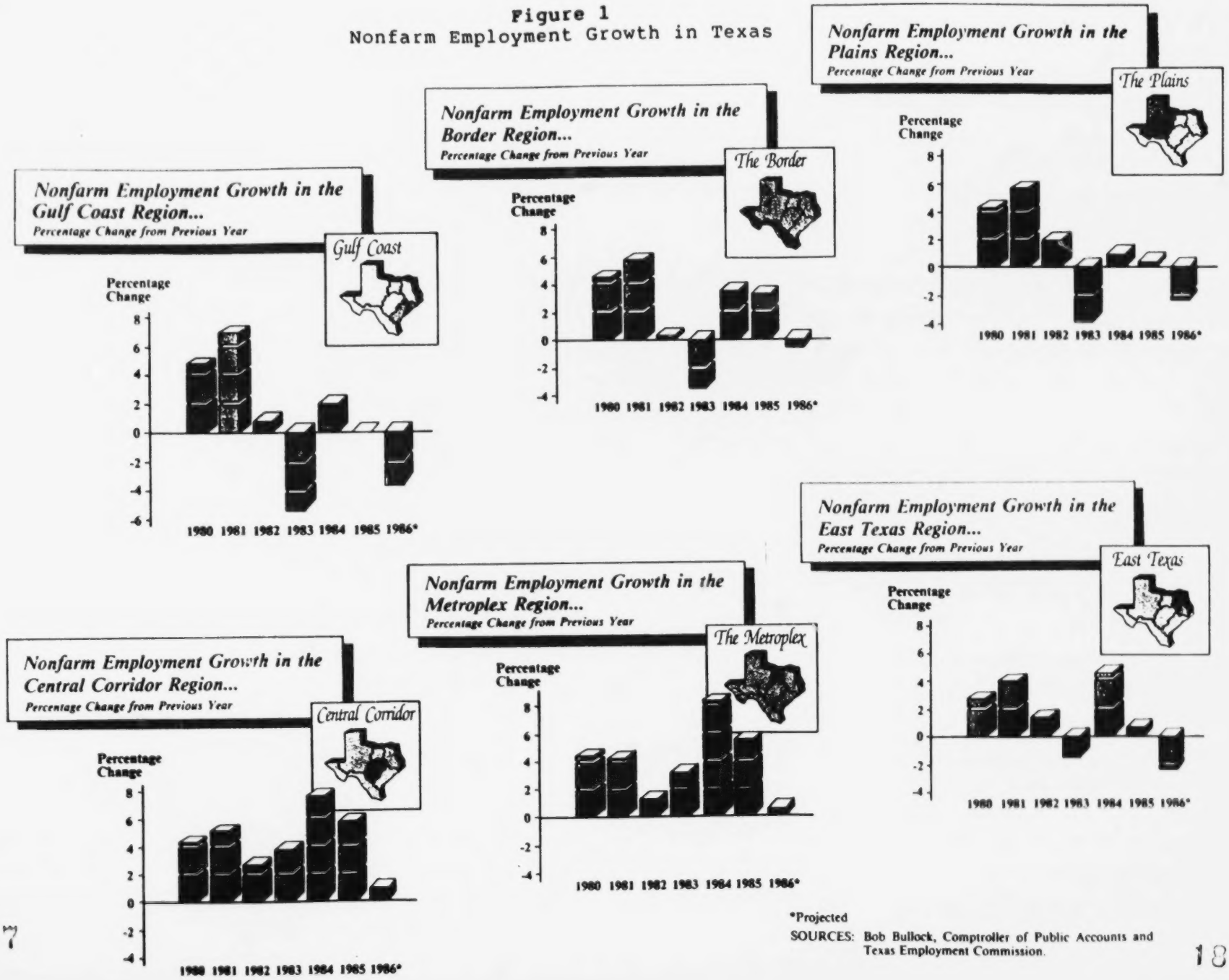
A major shift occurring in all regions of the state, is the relative decline in importance of agriculture and oil-related employment. Figure 1 displays the yearly growth of each region in "non-farm" employment, which includes mining, construction, manufacturing, trade, transportation and public utilities, finance, insurance real estate, government, and other services.

Types of employment expected to be of importance in each of these regions are as follows. These views are primarily based on the Texas Office of the Comptroller's monthly newsletter, **Fiscal Notes**, and on statements obtained from persons who are knowledgeable about the organizations listed in Appendix IV.

Gulf Coast Region. Struggling to recover from the precipitous drop in oil-related employment, Houston and the Gulf Coast region generally are emphasizing economic diversification that builds on their existing base of employment--sectors that were often not emphasized during the recent decades of oil-driven growth:

- International businesses and services
- Tourism, trade shows and conventions
- Health-related institutions, such as the Texas Medical Center in Houston, and health-related businesses and services
- Shipping and transportation
- Aerospace R&D and operational support of NASA manned space programs.

Figure 1
Nonfarm Employment Growth in Texas



*Projected

SOURCES: Bob Bullock, Comptroller of Public Accounts and Texas Employment Commission.

Border Region. Highly influenced by severe devaluations of the peso and other problems in Mexico, urban border centers such as Laredo, McAllen and Brownsville are putting more effort into attracting tourism and manufacturing, with Harlingen pushing for an increased level of defense contracts. The falling peso has helped stimulate the "twin plant" (maquiladora) industrial phenomenon (in which parts that are manufactured in the U.S. are assembled in Mexico with labor costs that are now comparable to those in the Far East after adjusting for transportation). Agriculture continues as a mainstay of employment in much of the region.

Plains Region. Even more than in many regions of Texas, employment in the Plains has been particularly hard hit by falling oil prices. As a region it appears to be staying close to its agricultural roots in seeking new avenues for economic diversification--with woolwashing in Eaton, the development of truck crops such as the seedless watermelons in Munday, and premium table wines in Lubbock being but three examples.

East Texas Region. The economy of East Texas has always been based to a large extent on its natural resources--wood, petroleum, and coal. Perhaps even more intensely than in most other regions in Texas, leaders in different parts of the East Texas region are experimenting with various strategies for developing new sources of employment which emphasize regional collaboration more than competition. The Technology Partnership Organization in Tyler-Longview, for example, reports that doing more to support the emerging needs of existing businesses has turned out to be an effective, albeit indirect, way to attract new firms to the area.

Metroplex Region. Although in an area well-suited to agriculture and with abundant natural resources, the economy of the Metroplex--particularly Dallas and Fort Worth-- has grown to be dominated by manufacturing, commerce, finance, tourism, and services.

Already the most diversified of the six regional economies, the Metroplex appears to be increasing its base by developing new centers for merchandise trading and distribution and for tourism. It is also building on its previous strength in electronics, aerospace and military hardware and systems manufacturing by becoming something of a national center for high technology telecommunications companies.

Central Corridor Region. The Central Corridor, like the Metroplex, has prospered independently of its geological and natural resource base--a factor which has helped both regions to weather recent economic downturns that have plagued the state. The principal economic centers of the region, with the exception of Bryan-College Station area, lie along Interstate Highway 35 between Waco and San Antonio, a characteristic which gives the region its name.

With more current employment in government, education, and other services (some 40% of the total) than in other regions, the future outlook is largely one emphasizing high technology, such as the establishment of the much publicized Microcomputer Corporation (MCC) in Austin, the emerging biosciences emphasis in San Antonio, and the research/development/manufacturing parks being developed in the Bryan-College Station area, in part due to the College Station 2000 and the Bryan forward task force activities.

Implications

In light of available information, the above outlooks may be thought of as preliminary caricatures which give a feeling for:

- the different development strategies that are emerging in different regions of the state;
- the differences in jobs and needed skills that they will lead to; and
- the need for future-oriented information on employment to support decentralized--but coordinated--planning and development of job-training in the major regions of the state.

The central planning issue posed by this section of the report is not so much the degree to which the above vision is valid or adequate, but rather the degree to which this type of information should be systematically gathered and used for purposes of increasing the effectiveness of postsecondary technical, vocational, and adult education in Texas.

MAJOR INFLUENCES

We turn now to the factors expected to significantly influence employment and training needs during the decade ahead, using four general categories that are frequently used for this purpose: technological, economic, social, and political. These factors are more fully described in Appendix II, which readers may wish to scan before reading on.

Technological Developments

Without doubt, one of the greatest influences on the nature of employment in recent decades has been the arrival of new technologies. Future technologies are significant for the planning of technical and vocational education in at least two ways: 1) the new technologies will bring new knowledge and skill requirements; and 2) they bring new ways through which to impart knowledge and develop needed skills. Important technological innovations of both types currently "in the pipeline" include the following:

New Technological Bases for Employment

- the emergence of powerful tools for manipulating **information**; large scale information utilities; and "intelligent" technologies for instruction, process control, etc.
- advances in **biotechnology**, with applications in medicine; farming; animal husbandry; energy and chemical feedstocks
- the emergence of **computer integrated manufacturing (CIM)** involving integrated systems for design, development, manufacture, inventorying, shipping, billing, etc.
- the evolution of **office automation** technologies for management information systems, accounting, planning, budgeting, communications, etc.

New Technological Bases for Postsecondary Technical, Vocational and Adult Education

- **"intelligent" computers**, including mainframe, mini and personal units with applications now involving all of the technologies listed below:
- **laser videodiscs**, making possible interactive programming for either instruction (as in training to use a new type of technology on the job) or reference (as in trouble-shooting for maintenance of that technology on the job)
- **authoring system** software, through which instructors or other personnel who are not themselves programmers, can translate conventional instructional courseware into a high tech equivalent having greater instructional efficiency and effectiveness
- **expert system** software which enables computers to duplicate many reasoning tasks necessary for "intelligent computer assisted instruction" (ICAI).
- **integrative delivery systems**, such as the "teleport" concept envisioned in the Master Plan, through which applications of the above technologies could be integrated with a satellite transmission network for instruction at the workplace as well as at public educational institutions.

More information on emerging technologies for instruction and training is provided in Appendix III. These new state-of-the-art technologies will need to be carefully articulated and integrated--both with each other and with more conventional modes of delivery--if a flexible, multifaceted system for vocational and technical adult education is to emerge which can be adapted to regional needs and modified as those needs change.

Economic Ramifications

Although high technology has often proved to be a significant source of wealth and employment for regions in which it has flowered, it has proven to have a number of economic ramifications that are not always recognized.

These include:

- Economic impacts associated with international economic interdependence, including significant escalation in international debt (which is increasingly drying up the potential for investment in employment-creating new ventures);
- High technology-fueled "job exportation" (in which the labor-intensive portions of manufacturing and assembly are shifted to countries of the world having lower labor costs than in the U.S.); and
- A growing recognition that high technology applications may be downgrading the general level of domestic employment as well.

The **conventional** wisdom has viewed the emergence of new high technology employment as bringing with it a requirement for higher skill levels, more demanding schooling, and something of a ripple effect in which a range of high paying jobs throughout the region are created.

A less optimistic view has emerged from extensive research and analysis by Henry Levin and his associates at Stanford University's Institute for Research on Educational Finance and Governance using data from the Census Bureau, the Bureau of Labor Statistics and other sources:

> "The proliferation of high technology industries and their products is far more likely to reduce the aggregate skill requirements of jobs in the U.S. economy than to upgrade them; and that the expansion of the lowest skilled jobs in the American economy will vastly outstrip the growth of high technology ones."

This outlook emphasizes how, although new growth of high technology does bring new sources of revenue and some new highly skilled jobs to a region, the number of existing workers subject to "technological unemployment" greatly exceeds the number of highly skilled jobs thereby created. The significant employment growth therefore occurs in "low end" service jobs, and the aggregate spending power of people in the region may actually decline.

Surveys of the entire literature on this question reveal no clear answer as to which view is more valid. Spenner (1985), for example, in a

critical analysis done for the Illinois 1990's Work and Education Project, concluded that:

> **"Nothing in the available evidence suggests either a dramatically increased or reduced role for schooling and/or training."**

Two premises held by the project team should be inserted at this point:

- Regardless which of the above views may ultimately prove the most correct, Texas as a state cannot afford to avoid playing the "high tech card." The crucial question rather, should be, "What policies should be pursued to maximize the beneficial effects of a high technology society, while minimizing the negative ones?";

- The data underlying the views contrasted above should not be considered as "cast in concrete," needing only to be better understood and then used by planners. The outcome of this pivotal economic issue may depend more on economic policies yet to run their course than on accurate analysis of recent trends involving technology and employment.

To illustrate the relevance of these premises, consider the following three "alternative future" scenarios:

1. **A "superindustrial" workplace as America's predominant economic development strategy**--in which the use of expensive human labor is minimized in making high quality standardized goods by means of highly automated technologies. Economic growth might be robust, but obsolescence-based unemployment and the growth of the low-skill service occupations would also be maximized. This scenario would present postsecondary vocational, technical and adult education with a highly polarized set of needs, and the demand to provide technical training that might greatly exceed actual demand in the workplace.

2. **Protectionist trade policies as America's predominant economic development strategy**--in which an attempt is made to retain the current occupational profile as long as possible by suppressing imports of steel, automobiles, and other products in which the U.S. has a substantial historic investment. Forced retraining and obsolescence-based unemployment would be minimized, but so would economic vitality. This scenario would call for a continuation of the status quo in postsecondary vocational, technical and adult education.

3. **A knowledge-based workplace as America's priority economic development strategy**--in which the economy shifts from an emphasis on standardization to the use of new "intelligent person/tool" partnerships to support the customizing of products, services, and the way in which they are generated to meet situational needs. The United States is well positioned to lead and perhaps even dominate this market because of its relatively well educated workforce and entrepreneurial cultural traditions. This scenario would require advanced methods and delivery systems for retraining and "sustainable occupational change" involving a balanced mix of specialized and basic knowledge as the major agenda of postsecondary vocational technical, and adult education.

Helping to influence which type of orientation is pursued regarding the development and exploitation of "high technology" (both in the nation and in the state) could be an important priority in the agenda for leaders of the business and education community in Texas. Meanwhile, as the Stanford researchers point out:

> The educational system should strengthen the analytical and communicative skills of students, not because of the needs of high technology, but because such skills will help them deal with the changing political, economic, social, and cultural institutions they will face in their adult lives.

Social Issues and Impacts

Social factors expected to significantly influence technical, vocational and adult postsecondary education include the following:

- **Immigration.** Especially in urban regions of Texas such as Houston, the influx of a relatively unskilled population having a high need for job-related training is often associated with a difficulty understanding English and an unfamiliarity with the procedures through which help (such as training in English and as a second language) can be obtained.

- **Increasing ethnic and cultural diversity in the workplace.** The number of young entering the workforce will decrease as the number of minorities as a percentage of the youth workforce increases. Hispanic, Black and Asian cultures (each of which is significantly different as regards workplace life styles and motivations) will continue to grow faster than the Anglo culture.

- **Increasing social problems affecting the workforce.** The number of high school dropouts is expected to increase, with 25% ninth graders not graduating. For minorities and the poor, the rates may even be higher. Functional illiteracy is expected to worsen among this group, with strong implications for job training. Other problems, such as drug abuse, also need to be considered.

- **Social attitudes.** Attitudes in different regions of the state may differ significantly as regards the value to be put on "state of the art" training and employment opportunities. Texas workers who are less well paid and less well educated often have mixed feelings about the occupational and social influx of high technology.

Political Priorities and Perceptions

Among the general political factors which will influence the future of the workplace--and training for work--include the following:

- The growing political power of "non-traditional" interest groups, especially non-Anglo ethnic groups and the elderly which may be expected to hold strong views regarding various political agenda that are more or less relevant to vocational and adult education (e.g., "**workfare**").

- A rising "social dependency" ratio of retired as against working persons, which also can be expected to motivate concern for job training.

To ensure that this working paper would contain not only general, but highly specific factors, the project team conducted a brief telephone survey of knowledgeable professionals throughout the state who could, we hoped, describe the politically influential "leadership visions" regarding our topics of study. To the extent feasible, we asked each:

1. to identify significant activities and plans "in the pipeline" which, when implemented, will lead to new types of employment in different regions of the state;

2. to comment on the "state of the art" through which the linkage between emerging employment demand and skills training needs is established and used in Texas; and

3. to identify other particularly knowledgeable experts who could shed light on these developmental issues and agenda.

Their views may be summarized as follows:

- A considerable amount of coordinated economic diversification and development appears to be happening in some regions of the state, but it is by no means commonplace; state-wide coordination of such efforts appears to be particularly lacking; and there is apparently no single effort being made to pull this picture together.

- The Coordinating Board could make a significant contribution to the future well-being of the state by using its responsibilities for technical, vocational, and adult postsecondary education planning as a focus around which to help foster this type of proactive coordination.

- To do so would necessarily involve the collaboration of all agencies and actors having a either statutory authority for employment research, analysis and/or training, or a vital "stake" in the outcome of such an activity.

- Illustrative members of such a consortium might include the Texas State Occupational Information Coordinating Committee, local private industry councils (PICs) who administer training-related activities funded by the Federal Job Training Partnership Training Act), program leaders from community colleges and representatives of economic diversification taskforces throughout the state.

- There appears to be no single source through which such taskforces and other currently important activities throughout the state dealing with economic development can be identified.

Implications

The **Master Plan** for Postsecondary Technical, Vocational, and Adult Education lists eight topic areas as priorities for training and development. They are listed below, together with the regions of the state for which each may be most essential:

- **Agriculture/Biotechnology/Biomedicine** (Plains/Central Corridor)
- **Energy** (Gulf Coast; Plains)
- **Materials science** (Gulf Coast; Metroplex)
- **Marine Science/Aquaculture** (Gulf Coast)
- **Aerospace** (Gulf Coast; Metroplex)
- Telecommunications (Central Corridor; Metroplex)
- Manufacturing science (potential for all regions)
- Automated manufacturing and office automation (Metroplex).

As before, the central planning issue here is not so much whether these regional agenda are all that they should be. Rather the issue is: what the postsecondary technical, vocational, and adult education system in Texas needs to do if it wishes to anticipate future needs in these areas and to meet these needs using state of the art instructional delivery technologies.

Planning for a Responsive Training System. Figure 2 presents a schematic diagram of a generalized process model through which public/private initiatives for influencing the future can be implemented successfully. If adapted appropriately, it might prove useful as an approach through which all major parties at interest in postsecondary technical, vocational, and adult education could collaboratively respond to the planning issues highlighted herein.

This working paper, as noted in the introduction, may be considered a preliminary exploration of the basic "intelligence questions" (Phase 1) needing to be understood if the proactive objectives of the Master Plan are to be implemented successfully. The remaining phases described on Figure 2

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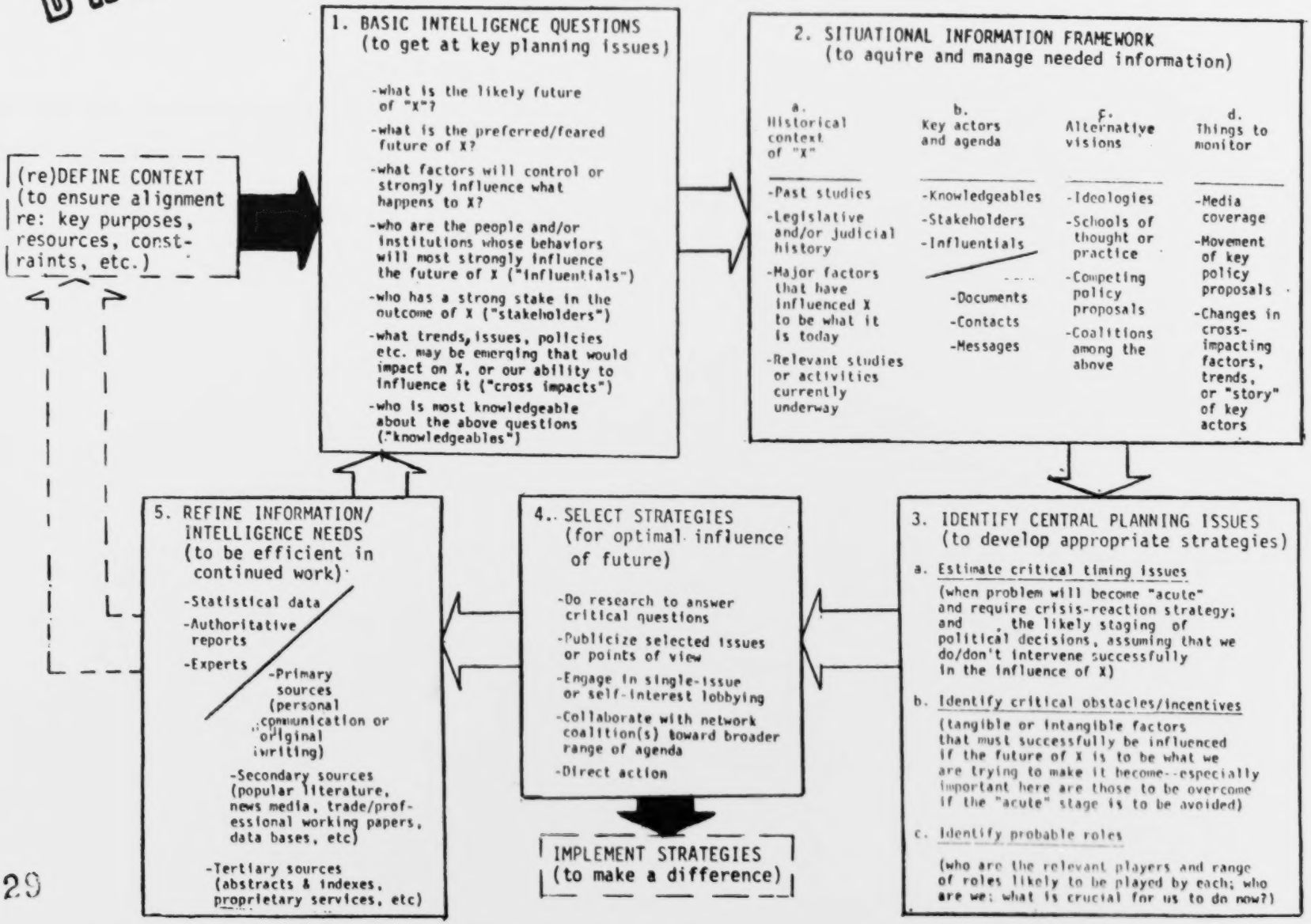
Figure 2

THE STRATEGIC INTELLIGENCE CYCLE:

AQUISITION AND MANAGEMENT OF INFORMATION FOR INFLUENCING THE FUTURE


(re)DEFINE CONTEXT
(to ensure alignment re: key purposes, resources, constraints, etc.)
1. BASIC INTELLIGENCE QUESTIONS
(to get at key planning issues)
-what is the likely future of "X"?
-what is the preferred/feared future of X?
-what factors will control or strongly influence what happens to X?
-who are the people and/or institutions whose behaviors will most strongly influence the future of X ("influentials")
-who has a strong stake in the outcome of X ("stakeholders")
-what trends, issues, policies etc. may be emerging that would impact on X, or our ability to influence it ("cross impacts")
-who is most knowledgeable about the above questions ("knowledgeables")
2. SITUATIONAL INFORMATION FRAMEWORK
(to aquire and manage needed information)
a. Historical context of "X"
-Past studies
-Legislative and/or judicial history
-Major factors that have influenced X to be what it is today
-Relevant studies or activities currently underway
b. Key actors and agenda
-Knowledgeables
-Stakeholders
-Influentials
-Documents
-Contacts
-Messages
c. Alternative visions
-Ideologies
-Schools of thought or practice
-Competing policy proposals
-Coalitions among the above
d. Things to monitor
-Media coverage
-Movement of key policy proposals
-Changes in cross-impacting factors, trends, or "story" of key actors
3. IDENTIFY CENTRAL PLANNING ISSUES
(to develop appropriate strategies)
a. Estimate critical timing issues
(when problem will become "acute" and require crisis-reaction strategy; and , the likely staging of political decisions, assuming that we do/don't intervene successfully in the influence of X)
b. Identify critical obstacles/incentives
(tangible or intangible factors that must successfully be influenced if the future of X is to be what we are trying to make it become--especially important here are those to be overcome if the "acute" stage is to be avoided)
c. Identify probable roles
(who are the relevant players and range of roles likely to be played by each; who are we; what is crucial for us to do now?)
4. SELECT STRATEGIES
(for optimal influence of future)
-Do research to answer critical questions
-Publicize selected issues or points of view
-Engage in single-issue or self-interest lobbying
-Collaborate with network coalition(s) toward broader range of agenda
-Direct action
IMPLEMENT STRATEGIES
(to make a difference)
5. REFINE INFORMATION/ INTELLIGENCE NEEDS
(to be efficient in continued work)
-Statistical data
-Authoritative reports
-Experts
-Primary sources (personal communication or original writing)
-Secondary sources (popular literature, news media, trade/professional working papers, data bases, etc)
-Tertiary sources (abstracts & indexes, proprietary services, etc)

comprise a more general "road map" which can be used to help set up agenda for research and development which the Coordinating Board's Division of Community Colleges and Technical Institutes may wish to support during the months ahead.

RECOMMENDED INITIATIVES FOR POSSIBLE ACTION

In response to the Coordinating Board's request for recommended action items, the project team has identified seven specific priorities. Each of them not only reflects the views of most knowledgeable professionals surveyed; they also represent immediate action items for increasing the feasibility of implementing a cost-effective, state of the art delivery system such as is envisioned by the Master Plan. In brief, they are as follows:

1. Design and pilot test a flexible strategic planning and development approach for community college systems (specific focuses to be selected at state, regional, and local level).

2. Develop and pilot test procedures for using state, regional, and local employment projections in PSI-level program planning.

3. Technical assistance and consulting services to postsecondary institutions wishing to upgrade their capacity to do implementable strategic planning and development involving state of the art technologies for the workplace.

4. Coordinate and facilitate a process for instructional planning based on employment data and projections.

5. In-depth study of selected planning issues, such as the "Stanford argument" noted in the Economic Ramifications section above, and its implications for Texas.

6. Systems analysis and preliminary design of a public/private initiative for delivering postsecondary vocational, technical, and adult education/training courseware via "teleport" technology involving all six major regions of the state.

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THE FUTURE OF THE WORKPLACE IN TEXAS:

A Preliminary Identification of Planning Issues for Technical, Vocational, and Adult Postsecondary Education

APPENDIX

I. Project Personnel

II. Factors Influencing the Workplace in Texas

III. Important Technologies for Education and Training

IV. Significant Sources of Unpublished Information on Future Employment in Texas

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APPENDIX I

The Project Team

This working paper was produced by a project team assembled by O. W. Markley and Associates, a group of professionals engaged in future-oriented research, training, consulting, and development. Subsequent research and training on topics covered by this working paper will be conducted by **The Institute for Strategic Innovation**, a new private sector organization whose mission is to promote sustainable development through the fostering of future-oriented, collaborative public-private initiatives.

The project team members were as follows:

Karla M. Back, President of O.W. Markley and Associates, is Assistant Dean of Business and Technology at Galveston College and a doctoral student at Texas A & M. Having an extensive background in long-range planning and assessment of postsecondary and secondary vocational, technical, and adult education in Texas, she served as project supervisor.

Gay Carter is Reference Librarian and Head of the Government Documents Collection at the Neumann Library, University of Houston-Clear Lake. She conducted literature research and helped organize the bibliography for the project.

Christopher J. Dede is Professor of Education and Studies of the Future at the University of Houston-Clear Lake. Dr. Dede was a Policy Fellow at the National Institute of Education where he wrote "Higher Education in Texas: Issues for the 1980's." He has also been a visiting scientist at both MIT and the NASA Johnson Space Center where he worked on educational applications of artificial intelligence technologies. He is principal author of Appendix II of this report.

Patricia Garrett is Head Reference Librarian and Acting Director of the Neumann Library, University of Houston-Clear Lake. She conducted literature research and helped organize the bibliography for the project.

O.W. Markley, Chairman of O.W. Markley & Associates is Associate Professor of Human Sciences and Studies of the Future at the University of Houston-Clear Lake. Dr. Markley has led a number of future-oriented educational policy research studies for the U.S. Office of Education, the National Institute of Education, the California Department of Education's Office of Adult Education, and does training in change management for organizations such as the NASA Johnson Space Center and Tenneco, Inc. He served as project leader and is the principal author of the working paper.

Timothy R. Sullivan is a graduate student in the UH-Clear Lake Studies of the Future Program and principal of TRS Research International, a firm specializing in high technology applications of information research, data base design and implementation, and applied market research. He contributed to the identification and analysis of instructional technologies.

Pam and David Durand "processed the words."

Factors Influencing the Future of the Workplace in Texas

A. Technological Factors.

Highly Probable/Almost Certain

- *the emergence of very powerful tools for manipulating information*--the price of computer and telecommunications power is dropping, while performance is increasing. Coupled with advances in artificial intelligence, the emerging universality of digital code is creating a synthesis between computer and telecommunications devices that will result in new types of information products. These evolving tools offer corporations access both to greater amounts of information and to powerful methods for extracting knowledge and wisdom from this data. This has implications for product development, process innovation, office and factory automation, and institutional management strategies. Businesses based on information are a growing proportion of the Texas economy, but the state is still building on a predominantly preindustrial and early industrial occupational base. Its proportion of jobs in agriculture and construction rank well above the national average; transport, retail, finance, and personal services are at about the U.S. average; professional services, public administration, and manufacturing are below the median proportion nationwide. The fastest growing sector of the state economy is the information sector; for example, by 1990, expansion of the printing, publications, and communications industries is expected to generate an additional $5 billion in annual output, $1.4 billion in annual earnings, and 71,000 new jobs.

- *advances in biotechnology*--types of innovations on the immediate horizon include:
  - --vaccines to protect against viral diseases
  - --improved methods for organ transplantation
  - --techniques for curing hereditary diseases (such as hemophilia)
  - --crops which make their own fertilizer
  - --plants which thrive on land presently considered barren because of its aridity or salinity
  - --ways to improve the growth and health of farm animals
  - --low-cost renewable fuels (including methane, hydrogen gas, alcohols)
  - --new sources of raw materials for the manufacture of plastics, paints, artificial fibers, and adhesives

--microbes which can aid in ore extraction
--improved systems for controlling pollution

Texas, with its agricultural heritage and the Houston medical complex, is well positioned to become a leader in these technologies.

- *the emergence of computer integrated manufacturing (CIM)*--computer assisted design/computer assisted manufacturing (CAD/CAM) is evolving into CIM, which will link all aspects of the production and distribution of goods. Occupational roles involving design, development, manufacture, inventory, service, vending, financing, marketing, managing, and personnel will all be affected, with rapid shifts in skills needed. Because of gains in productivity associated with CIM, by the year 2000, less than 10% of the American workforce will be involved in manufacturing (half of 1980 levels), and these remaining jobs will require sophisticated skills.

- *the evolution of office automation*--word processors, data bases, and spreadsheets are only early stages in the development of advanced office environments. Many shifts in occupational roles are expected as workstation interconnections, customized decision templates for each job, and expert systems for standardized tasks transform current information management approaches. Already, many middle management jobs are disappearing as information technologies assume the role of filtering and synthesizing operational information for high level decision makers.

- *elimination of some service jobs*--just as large computers eliminated many clerical positions, so the next generation of information technologies may be used by service providers to cut costs. For example, bank machines are reducing the number of tellers needed; telebanking may eliminate some branch offices. Home shopping via the television could have a similar effect on many retail sales positions. In Houston, for example, one UHF station has already converted to a "Home Shopping Network."

Reasonably Probable

- *new capabilities for instructional technologies*--individualization, intermixing, increased quality, cost decreases, and multiple options are all increasing each year.

Individualization

The evolution of narrowcasting, interactive videodisc, and videotex all indicate rapidly growing capabilities for tailoring information to user needs. Over time, the passive, spectator role for students will be increasingly replaced by opportunities for

directed response to queries, for exploration via simulations, and for creative interchange through artificial intelligence software. Simultaneously, networks capable of interconnecting all users and transmitting huge amounts of information among them will gradually appear.

Intermixing

The growing shift to use of digital code will allow the increasing synthesis of data, video, audio, and software signals. The "tower of Babel" problems now prevalent with incompatible devices will gradually diminish, and telecommunications will become the unifying medium for all information technologies. Combining the attibutes of the computer, television, radio, videodisc, copier, telephone, and printing press will produce new tools with great power for facilitating learning. Because of this synthesis of technologies, the struggle for control of the information economy will intensify among corporations marketing computers, telecommunications devices, and radio/television/print media.

Quality

Capabilities never before possible are becoming economically feasible because of advances in processing power, memory storage, and delivery systems. Very high resolution; freeze-frame, zoom, and multiple images; freedom from electromagnetic interference; and portability all will combine to enhance the power of the medium to educate students. Just as "talkies," stereo, and color expanded the experience of users, so will these new attributes contribute to the motivational and instructional force of programming.

Cost Decreases

In contrast to most technologies, information tools have become less expensive year by year for equivalent power. For example, the amount of information which can be processed by computers has been doubling every two years per unit cost and time for the past four decades, and this trend will likely continue until the year 2000. Fiber optic cable is cheaper than copper cable, smaller, lighter, more reliable and secure, immune to electromagnetic interference, and has much greater capacity. Optical scanners which two years ago cost $2000 now retail for $7. Because of these and other technical advances, the proportion of the population which can afford access to high quality information services is steadily expanding.

Multiple Options

The range of technologies by which users can choose to receive a service is growing rapidly. For example, in the near future educational programming will be deliverable by broadcast, one-way cable, two-way cable, direct broadcast satellite, instructional television fixed service (ITFS), low power television, high definition television (HDTV), digital television, videotape, digital optical disc, and videodisc. Manufacturers, suppliers of services, and consumers alike are confused by this plethora of alternatives and uncertain as to how to invest their resources. An "ecology" of information technologies is emerging, in which each tool has its own "niche" determined in part by cost, attributes, installed base, and the availability of quality programming. The size of the total "information ecosystem" is

growing, as expenditures on information technologies continue to rise faster than overall personal consumption. The shape of each niche is shifting, both as new technologies with greater capabilities or lower costs cut into the market share of older technologies and as the boundaries between technologies increasingly blur.

- *a new type of content in the work-related curriculum*--types of knowledge and skills previously too expensive to be included can be taught on a cost-effective basis using the new information technologies. Words, symbols, and line drawings are cheap and powerful; historically, postsecondary education has tended to emphasize subjects which can be taught completely in this manner. A difficulty which such an approach poses is that words and symbols are good for teaching descriptive and declarative knowledge, but no so good for conveying complex procedural skills such as laboratory procedures, diagnostic strategies, advanced writing, equipment troubleshooting, and instrumentation usage. Historically, occupational training has been hampered by the high cost of instruction for complex, higher order procedural skills, but technological simulation provides a relatively inexpensive and managable approach to teaching this type of knowledge in an outcome-oriented manner. For example, a single Compact Disk/Read Only Memory (CD-ROM) can now hold as much information as about 1500 floppy disks, 15 four drawer file cabinets, or 500 books. Any program, file, or document on the disk can be accessed in less than three seconds. The CD players costs around $600 and attach to standard microcomputers; the disks cost about $5 each to produce in quantity. The expense to publish a comperable amount of information on paper or floppy disks is approximately $5000, a cost advantage of approximately 1000:1 for CD's (this is equivalent to printing a typical novel for about a penny a copy). In addition, optical disks offer the advantages of compactness, portability, electronic cross-referencing, and rapid access. For advanced technological simulations, their ability to store text, program code, digitized voice, graphics, music, and images on a single disc is very useful.

Conceivable/Uncertain

- *"learning-while-doing" as a major training method*--workplace tools may increasingly include intelligent devices that act as job performance aids and simultaneously audit user skills to allow credit for real world accomplishments. Distance delivery of interactive educational services through sophisticated telecommunications networks may alter the typical "classroom" experience. Postsecondary educational institutions will need to develop greater flexibility in its

systems of instruction and evaluation when knowledge no longer comes packaged only in three credit chunks. Many corporations are using the new information technologies as a major part of their retraining efforts, and experiments with technological delivery of non-credit continuing lifelong learning are being funded by the Kellogg Foundation, among others.

- *the emergence of large scale "information utilities"*--people need ways quickly to filter information from data, knowledge from information, wisdom from knowledge. Essential to this process are two factors: access to a wide variety of data, and tools/training for screening out "meaning" from "noise." An information utility would supply both of these commodities on a decentralized basis to clients (in this case, to postsecondary vocational, technical, and adult education). A recent study indicates that Texans are heavy media consumers and that the proportion of individual use grows with increased education.

- *new types of instructional devices*--"intelligent" tools which synthesize computer and telecommunications technologies. These open up new methods of teaching, including Socratic machine-based tutors, simulations with embedded coaches, elaborate empowering environments, and surrogate travel. Because of breakthroughs in storage devices, each student will have inexpensive access to massive amounts of data via interactive networks and optical discs. In addition, these devices can unobtrusively and cheaply measure key variables such as student time on task, response time to questions, percentage of errors in answering items, pattern of mistakes made, and tutoring sequences chosen (a cognitive "audit trail"). As a result, information previously unobtainable about individual performance can be garnered as a by-product of instruction without elaborate human recordkeeping. Further, as instructional devices are tailored to learner response and alternative pedagogical modalities tested, the success or failure of different approaches can provide important insights into the basic nature of higher order adult learning.

Long Range

- *partnerships between people and "intelligent" tools*--human beings and information devices have complementary cognitive skills and can work together to accomplish tasks more effectively than either the person or an automated device could working alone. The strength of the intelligent tool is solving sophisticated, but standardized problems; the human role in this cognitive partnership becomes primarily problem recognition and solving unusual problems. This role requires

higher order thinking skills such as creativity, flexibility, decision making given incomplete data, complex pattern recognition, information evaluation and synthesis, and holistic thinking. Developing a workforce with these capabilities implies a new definition of human intelligence, as the old definition increasingly becomes the function of information tools. This has major implications both for the preparation of new workers and for retraining the existing workforce, as the skills needed to perform an occupational role (or even the role itself) change rapidly. Texas postsecondary vocational, technical, and adult education system is asked to assume much of the regional responsibility for developing and conveying this evolving conception of "intelligence."

- *a differentiation between "training" and "education"*--with each having a different set of instructional methods. One way of conceptualizing the issue of what part of the curriculum is best adapted to technological delivery is to classify material which has a limited range of right answers to questions as "training;" in contrast, "education" would be the portion of the curriculum in which a question could have many possible right answers, or the correct answer is not known, or the question is not meaningful in terms of "right" and "wrong" responses. The "training" portion of the postsecondary vocational, technical, and adult curriculum may eventually be delivered in large part by "intelligent" teaching devices, particularly for introductory subject matter with large student populations. Training is best done in an individualized and interactive manner, and artificial intelligence based information technologies can recognize a limited range of right answers and can provide guidance on how to correct common mistakes. These instructional devices will not provide a comparable experience to a skilled faculty member working one-on-one, but are becoming increasingly effective and cost-efficient compared to an instructor attempting to train twenty to thirty students simultaneously. By using a combination of human instructors and intelligent tools, postsecondary institutions can more effectively accomplish both training and education: instructional devices providing a common foundation of basic skills and knowledge, and teachers working with information tools to build a mastery of complex occupational concepts (such as skills in the new definition of human intelligence) on this foundation.

B. Economic Factors.

Highly Probable/Almost Certain

- *growing global interdependence of Texas corporations*--an expanding proportion of their revenues will come from international sales, competition from foreign firms will continue to erode their domestic markets, and their financial strategy will be increasingly linked to world debt fluctuations. For example, Mexico owes U.S. banks approximately $25 billion; of the 17 largest American banks, 13 have more than half of their net worth in Mexican loans. Texas banks have heavy liabilities in Third World debts (as well as energy related loans, whose stability is linked to the Mideast situation).

- *increased uncertainty about short term economic trends*--the complexity of the world, national, and local factors which combine to determine regional prosperity makes long range planning very difficult. Warring coalitions of economists, politicians, business leaders, and educators disagree on the direction the American economy should evolve. For example, some argue for protectionist legislation and a resurgance of traditional industrial approaches, others see massive automation to reduce labor costs as the key strategy, and a growing group believes that the U.S. should transform beyond an industrial economy to a production system based on value added manipulation of knowledge. Each of these alternatives has different implications for the types and mix of occupational skills that postsecondary vocational, technical, and adult education should convey.

<u>Three Illustrative Scenarios</u>

- *a knowledge-based workplace as America's economic development strategy*--the economy shifts from standardized production to customized goods based on the individual needs of consumers (like having a tailor make all your clothes as inexpensively as buying them off the rack). A substantial global demand for made-to-measure products exists, and (unlike low wage rate or cheap raw materials cost industries) the United States is well placed to dominate this market because our highly educated workforce is the ideal prerequisite for person/tool partnerships. The most rapidly expanding portion of the Texas economy is information based jobs, which increased 93% in the

state between 1973 and 1983 compared to 36% nationwide. The information technology subsector of information based jobs grew most rapidly, followed by information services, media, information trade, and research & development. (Many of these jobs were not advanced occupational positions, however.)

- *protectionist trade policies as America's economic development strategy*--to restrict international competition and preserve current domestic industries. The United States may seek to retain its present occupational profile as long as possible by suppressing imports of steel, automobiles, and other products in which we have a substantial historic investment. Forced retraining and unemployment through obsolescence would be minimized. While new, high technology sectors would slowly develop, their evolution would be retarded by counter-protectionist tactics from other nations and by the massive drain of investment capital needed to sustain our aging traditional industries.

- *a "superindustrial" workplace as America's economic development strategy*--the nation may seek offset its greater costs for energy, materials, interest and inflation by minimizing human labor in making high quality standardized goods (such as cars and refrigerators). As a result, many middle level occupations would largely disappear (in recent years, other than when an entire employer has gone out of business, the majority of layoffs have been intermediate level positions). A few engineers, scientists, and bureaucrats would coordinate the superindustrial economy, while most people would either hold low wage service jobs (waiter, sales clerk, janitor) or be unemployed. For example, last year almost 60% of the new jobs in the American economy had starting salaries of less than $7000 per year (in the late 1970s, less than 20% of new jobs had such a low starting salary).

In Texas, competing groups are pushing variants of these alternative development strategies for this region. Which coalition will prevail is unclear.

- *an overall loss in purchasing power for potential students*--in constant dollars, median family income is six percent less than in 1973, and "discretionary" income (the amount left over after mandatory expenditures such as taxes, housing, food, etc.) is down even more sharply. Also, loss of domestic market share to foreign competition has cost many U.S. jobs, so that

structural unemployment now averages seven percent even in times of relative prosperity. Since 1980, the interest on the federal debt has increased to over $1000 per person per year (and will reach $2300 per year by 1990 if equivalent deficits continue). Nationally, personal debt has risen over three times faster than income during the last two years, and the ratio of personal debt to income has set new records for the last five years. All these forces impact on the amount of funding Americans will spend on educational services. Texas ranked only 34th among the states in money spent per student on precollege education in 1985; its average teacher salary was 24th among the states. Currently, Texas ranks 47th in the nation in the Standardized Aptitude Test scores of its teacher certification applicants. This low expenditure level has its price; the state is 42nd in the percentage of its youth who graduate from high school--almost one in three Texas ninth graders do not receive a high school diploma.

Reasonably Probable

- *increasing national emphasis on regaining economic competitiveness*--federal antitrust, depreciation, investment, and tax codes may be dramatically altered. Texas will be seen as a key component in any U.S. economic redevelopment strategy, since it contains three of the ten biggest cities, the third most active port, most of the border with Mexico, much of the nation's refining capacity, one of the country's largest medical complexes, and numerous other crucial resources.

- *continuous vocational/technical education becomes a key corporate strategy*--skilled labor and proprietary technologies are recognized as the most powerful barriers to foreign competition. American firms invest heavily in occupational training as a source of sophisticated workers, who can develop and implement complex technological processes that reestablish this country's preeminence in advanced industrial products. Workers currently employed will still be over ninety percent of the U.S. labor force for most of the next decade, so retraining this group to the needs of a knowledge-based economy is vital. Internationally, America has dropped from second to seventh place in the level of skilled workers, in part because of an aging population. American firms spend an average of only $300 per worker annually on training compared to $3300 per employee on capital investment. Estimates of "functional illiteracy" in our society range from twenty-five million to forty-five million people: the equivalent of the combined populations of New York, New Jersey, Pennsylvania, Delaware, and Maryland. Providing access to college and university services is not enough to resolve these problems: less than four percent of employees eligible for company-sponsored tuition assistance use these benefits. Texas postsecondary vocational, technical, and adult education system may be seen as a resource for improving corporate training.

- *major short term U.S. economic difficulties*--a negative balance of trade, growing federal deficits, and mounting Third World debts are destabilizing the U.S. position as "global banker." Additional American economic problems include $250 billion dollars of farm debt; defaults on energy and real estate loans in states whose economies are based on oil prices; $1 trillion of public physical infrastructure replacement (highways, bridges, dams, sewers) needed over the next decade, with proportionate capital equipment replacements necessary in the private sector; a very high real cost of money (interest rate minus inflation rate); and a rising tradeoff between the level of inflation and the level of structural unemployment. The U.S. is the most unequal in its distribution of wealth among the developed nations, and these trends are creating a situation of substantial disparities in income and corresponding concerns about crime and unrest. In Texas, the September, 1986 state budget deficit of $3.5 billion was the largest in U.S. history.

Conceivable/Uncertain

- *shifts in workers' affective and motivational skills*--new institutional systems for allocating power and responsibility may emerge in the workplace over the next decade, as patterns of authority shift from hierarchical structures to more decentralized, "bottom up" approaches. The knowledge based economy and emerging intelligent tools may require rapidly evolving institutional policies. Cultural forces coupled with dehumanized working conditions have weakened the Puritan ethic and the desire to perform quality work. Developing a new control mechanism that combines the speed and accountability of hierarchical authority with the democracy and shared knowledge of a more decentralized system will require a workforce adept at cooperation, compromise, and group decision making. Texas postsecondary vocational, technical, and adult education may be asked to develop affective characteristics which facilitate these skills, as well as to instill a greater interest in accomplishment as a source of self-worth.

- *work-related education a less attractive investment*--because of discrimination and underemployment. Some economists and educators argue that, while the proliferation of high technology industries will create some professional and technical jobs, on balance advanced technology is likely to reduce the skill requirements for most jobs in the U.S. economy.

If true, this would further erode the potential financial return from investing in postsecondary occupational training. Women as a group have much lower earnings than men; a college educated woman earns approximately the same amount, on average, as a white male who has only completed elementary school. This disparity is partially due to discriminatory forces in high status occupations, but also reflects the fact that women workers tend to be clustered in a few work roles (primarily clerical, nursing, and teaching jobs) which are not highly salaried. From an economic point of view, especially given the current troubled U.S. economy, women have less to gain from increased education than men do; similar arguments can be made for minority groups. Also, underemployment is increasing, as the number of educated persons grown more quickly than the number of jobs which require academic training (one in four workers today has a college degree). As a result, postsecondary educational experiences have rapidly become no guarantee of a high salary; as early as 1970-75, the wages for high school graduates ages 25-34 increased 32%, while those of comparable college graduates rose only 19%. Over the last fifteen years, the proportion of male college graduates who have had to settle for non-professional, non-managerial jobs has increased three-fold (for women, four-fold).

Long Range

- *a new model of postsecondary vocational, technical, and adult education*--In addition to serving the needs of students entering the workplace, postsecondary institutions aid in massive reeducation of adult workers. The curriculum shifts from performance fluency in "training" to developing the generic higher order skills in the new definition of intelligence. Evaluation measures for achievement and success are reconceptualized. An emphasis on other cultures and foreign languages is essential in preparing students for a workplace based on global markets. Faculty/tool partnerships in instruction are important in giving pupils experience and models for using information devices in problem solving. An alternative, technology-based model of instruction in postsecondary vocational, technical, and adult education evolves. Texas citizens would perceive regional prosperity as strongly linked to investment in sophisticated occupational training systems.

C. Social Factors.

Highly Probable/Almost Certain

- *growing emphasis on cultural and linguistic diversity in the workplace*--to sell products in other countries, American corporations need personnel who can effectively communicate in languages other than English. The ability to work flexibly within another cultural framework is also vital, as many countries across the world have radically different patterns of thought and belief than Americans. Texas has major resources of cultural and linguistic diversity, as discussed immediately below.

- *growing diversity in the American population*--by the year 2000, one of every three Americans will be non-white. Hispanic population growth is the highest of all groups; by the end of the 1980s, Hispanics will be the single largest minority group in the country. This population is concentrated; sixty percent of all Hispanics live in three states (California, New York, Texas). Minorities constitute the majority of school enrollment in twenty-three of the twenty-five largest cities in the U.S. Black and Hispanic participation in education declines dramatically at higher levels, and the majority of the few Blacks and Hispanics in higher education are enrolled at community colleges or predominantly minority institutions. Moreover, the proportion of Black and Hispanic high school graduates who go on to college is significantly decreasing. In Texas, minority populations comprise 35% of its population base and 46% of its youth. By 2010, minorities will be close to 50% of Texas total population. The state ranks 17th in its percentage of Black population, 2nd in Hispanic, and 5th in Asian American. A disproportionately high number of Asian Americans are enrolled in advanced higher education in Texas; a disproportionately low number of Blacks and Hispanics are enrolled.

- *almost half the poor in America now are children*--nationally, twenty-two percent of children under eighteen are poor. The impoverishment of experience that necessarily comes with low family income may handicap many of these children as workers or students. In Texas, the average 1985 welfare payment for needy mothers and children was $57 a month (46th among the states). Moreover, only 20% of single mothers in Texas are receiving assistance (compared to 80% in Pennsylvania). In Houston, one in five Black families in Houston had an income below the poverty level in 1985 (compared to one in twenty for whites). In 1983, twenty-seven percent of 3 and 4 year olds in Texas were below the poverty level. These children will be part of the postsecondary vocational, technical, and adult population in less than two decades.

- *the "typical" childhood is changing*--In 1955, sixty percent of the households in the U.S. had a working father, a housewife mother, and two or more school age children. In 1980, only eleven percent of homes fit that profile; by 1985, only seven percent. Separation, divorce, and remarriage are all increasing; if current trends continue, fifty-nine percent of the children born in 1983 will live with a single parent by age 18. In Texas, there are over five hundred divorces for every one thousand marriages.

- *troubled early childhood experiences*--American white teenage females are twice as likely to give birth outside of marriage as any other country studied; every day, forty U.S. teenage girls have their third child. Since very young mothers tend to have premature babies with low birth weights (a good predictor of major learning difficulties when the child gets to school), almost 700,000 babies of the 3.3 million born annually in the U.S. are "high risk" educationally. In 1985, one of every three babies in Texas was born out of wedlock (over 77% of all Black births). Texas ranks 14th among all states and the District of Columbia in its proportion of teenage births to all births. More than 16% of the babies born in Houston in 1984 belonged to mothers between the ages of ten and nineteen.

Reasonably Probable

- *declining postsecondary enrollments of traditional age students*--the "baby bust" generation of the 1960s is now entering colleges and universities; during the next decade, this will significantly affect attendance, since almost half of the total enrollment in higher education (and three-fifths of the undergraduate enrollment) comes from this age cohort. Between 1983 and 1993, the population aged 18-24 in the U.S. will decrease by 5.5 million, a decline of 18%. This decrease follows a long period of growth caused by the "baby boom" after World War II; for example, the 18-24 age cohort increased by 22 percent between 1970 and 1983.

- *growing numbers of older postsecondary students*--from 1983-1993, the number of people age 35 to 44 will increase 37 percent, and the proportion of adults seeking occupational training may grow. For example, because of economic shifts, needs for career mobility, and rapid technological developments affecting job skills, many workers will seek formal vocational/technical services (one-third of American

adults have changed occupations in the last five years). A "promotion squeeze" may add to the amount of career mobility: in the 1960s, many young people were entering a workforce with relatively few older personnel available to act as managers and supervisors. As a result of "many Indians, few chiefs," a large proportion of these older workers had high level job roles, titles, and salaries. Now the opposite is true: the "baby boomers" comprise a large senior workforce population, and few younger workers are being hired. The opportunities for meaningful promotion are much more restricted, potentially leading to some degree of job dissatisfaction. Current estimates are that, by 1992, half of all college students will be over 25, and twenty percent will be over 35.

Conceivable/Uncertain

- *an increasingly metropolitan Texas* --almost 80% of its citizens now reside in twenty-six metropolitan areas (the largest number of any state). Unlike almost all metropolitan areas in the U.S., many Texas cities have expanded both their core population and their suburbs. Houston grew over 45% in the 1970s; Dallas, over 25%. Texas cities' core and suburbs are strong divided along ethnic and socioeconomic lines: 14% of Houston Blacks live in the suburbs, compared to 69% in Miami and 46% in Los Angeles and Atlanta.

- *a rise in Texans' anti-intellectualism and a backlash against new information technologies*--less than 17% of Texans are college graduates (23rd among the states). The educated population is distributed very unevenly: Austin has one of the highest rates of doctoral holders in the nation, while other areas of the state are very low on this measure. Texans are seldom in the middle: they tend to be rich or poor, well educated or with little schooling. A recent study indicates that Texas workers who are lower paid and without much education have mixed feelings about the occupational and social influx of information technology.

Long Range

- *a shift in the characteristics of the American workforce*-- the "baby boom" age cohort moves into the ranks of senior workers and experiences a "promotion squeeze;" members of the smaller "baby bust" generation have multiple potential

employers competing for their services; and, due to changes in the "typical" childhood, younger workers are significantly different in their personality, culture, and experience from past generations. The goals, content, and methods of Texas postsecondary vocational, technical, and adult education alter in response to this changing clientele.

D. Political Factors.

Highly Probable/Almost Certain

- *growing political power of the elderly*--the proportion of the U.S. population over sixty-five in age is increasing, while the fraction under age twenty is shrinking. Senior citizens (17% of the population) have very high voter participation rates (40-45% of the turnout in elections); in contrast, 17% of potential voters under age thirty participated in the 1986 elections. Older people tend to be conservative in their political philosophy and more concerned about medical and social services for their age cohort than about education or economic development. In Texas, the state population is relatively young (less than ten percent of its citizens over 65) because of recent high immigration rates. (Even with all the recent immigration, Texas still ranks only 25th in the percentage of its citizens born in another state--almost seventy percent of its inhabitants are natives.) Thirty percent of its population is under 18; the state's median age is 28 years old.

- *a rising "social dependency" ratio*--this reflects the proportion of non-working people (elderly, children, ill, unemployed) to workers and is a measure of how much income must be transferred to keep the society stable. For example, in the 1940s, each retired person on social security was supported by over twenty workers; by the early part of the twenty-first century, this ratio will be less than one to four. High social dependency ratios create a political emphasis on creating jobs and increasing economic prosperity.

- *a strongly public Texas higher education system*--of the 156 postsecondary institutions in Texas, 98 are public and only 13 are independent/non-profit.

- *barriers to innovation in postsecondary educational practices*--the adage that "it is easier to move a cemetary than to change a university" may well be true. Even given massive external forces promoting the development of a technology-based model for higher education, building a market for a new approach will be challenging. Historically, the use of information technologies in universities has been restricted by three factors (other than the very limited capabilities these devices have had in the past). Attempts to innovate with

information technology have been less successful than expected because:

1) Faculty were often not trained to use new instructional devices; as a result, educational applications were unsophisticated and sometimes counterproductive.

2) A "critical mass" of faculty to prepare and exchange courseware was not reached; moreover, a level of capital investment sufficient to provide enough hardware access for students was not attained.

3) Academic reward systems were not geared to encouraging faculty use of technology; institutional funding formulas were not directed toward promoting productivity through telecommunications.

All three of these remain potential traps for universities seeking to pioneer in educational applications of the new information technologies. The dissemination of innovations in colleges takes place largely by emulation. An individual faculty member, teaching his students as his professors taught him, may change when a colleague with comparable responsibilities models a different, effective approach. A campus may implement an alternative instructional or administrative strategy when another university acknowledged as a leader describes the success obtained with a new approach. Innovative information technology products for higher education will need to be incremental (providing a bridge from old methods to new); generalizable to workplace situations (link to employment); targeted to tiers of adoption (leaders, rising stars, everyone); based around some hardware standard (risk reduction); and easily assessed in terms of effectiveness and efficiency.

Reasonably Probable

- *troubled citizens*--as the technological and bureaucratic complexity of society increases and the economic situation remains uncertain, social instability and change and a growing sense of powerlessness will cause difficulties in coping for many people. Reliance on the advice of "experts" for most decisions will continue to be necessary, yet citizens will resent making choices on blind trust. Heightened values conflicts will continue, as multiple special interest groups do battle on issues such as abortion, individual rights and responsibilities, immigration, protectionism, and biomedical manipulation.

- *a continuing movement for educational reform*--instructor certification will increasingly stress depth in disciplinary preparation rather than pedagogical competence. In Texas, as the "no

pass, no play" controversy demonstrates, revisions in educational practices will be heavily impacted by political and ideological factors. The rivalry among postsecondary institutions will increase as funding tightens and the state seeks to eliminate overlapping academic programs. The recent recommendations of the state task force on higher education (parallel to H. Ross Perot's committee which scrutinized pre-college instruction) follow the same pattern: prescriptively detailed, top-down, and focused on assessing readily measurable outcomes.

- *low statewide coordination of Texas precollege educational system*--funding is 46% state funds, 46% local, and 8% federal. This gives little leverage for centralized decision making and creates difficulties in articulation between precollege and postsecondary vocational and technical education. While "top down," the recent reforms mandated by House Bill 72 are unlikely to be implemented because they are unwieldy and expensive. For example, a second grade teacher is responsible for eight curriculum areas involving 214 "essential elements;" for a class of twenty-two students, that teacher must report on 4708 areas of student progress.

Conceivable/Uncertain

- *a new definition of "national security"*--military and geographic dominance is giving way to a more complex conception that includes economic clout. Japan is now a "financial superpower," spending little on her own defense, but nonetheless secure and strong. At a national level, increasing emphasis may be given to balancing weaponry power and strategic military alliances with economic strength and a positive balance of trade. This shift is likely to fuel funding for economic redevelopment, but may limit and politicize the options of domestic multinational corporations, as the interests of the state are weighed against the interests of shareholders.

- *a weakening of democracy*--financial pressures on citizens will intensify existing anti-taxes movements, and business groups will link anti-regulatory arguments to this cause. The result will be a pervasive "reduce governance" stance. Conflicting pressures will come from those who push for "strong leadership" to ride roughshod over inconvenient regulations and safeguards. Representative government will thus be eroded by pressures both for localism and for unitary authority.

- *changing social responsibility of corporations*--in addition to being responsible for "externalities" (such as pollution) and

for national security (through managing economic resources), companies are increasingly being held accountable for developing and maintaining human resources. This ranges from worker retraining to keep competitiveness in the global marketplace to some responsibility for placing workers in new jobs if a business fails. The ethics which corporations should follow in prioritizing simultaneous, sometimes conflicting responsibilities to workers, stockholders, customers, the region, and the nation are not clear.

- *corporate competition with postsecondary vocational, technical, and adult education*--a growing number of U.S. businesses are sponsoring large-scale internal educational programs. Some programs are intended to substitute for entry-level educational credentials as a means of job access; others provide an alternative to colleges and universities for obtaining advanced degrees. (For example, Wang Industries has the Wang Institute, a graduate school in computer science designed to internally produce corporate employees with a Master's degree. IBM, Xerox, GE, and AT&T now offer bachelor's degrees; the Arthur D. Little firm gives an M.B.A. in management; and the Rand Corporation offers a Ph.D. in Public Policy.) Most corporations would rather have public institutions do their training and retraining than mount internal programs in direct competition. However, many businesses are disatisfied with the quality of the services they receive from educators and--if a well developed, capital intensive model of corporate instruction were available--might implement internal, technology-based training as an alternative. Even if degrees were not offered in most of these programs, such a development would seriously erode the public adult retraining market; strong linkages between postsecondary education and business are needed to prevent this eventuality.

Long Range

- *coordinating knowledge production and distribution becomes the overarching function of postsecondary vocational, technical, and adult education.* This would include:
  - --anticipating emerging needs for knowledge in the business community

--developing in regional educational institutions the capacity for training appropriate levels of human resources with this knowledge
--working in partnership with business to enhance the economic effectiveness of current approaches and employees

Such a mandate could include expanding educational services to all adults, using partnerships among postsecondary educational institutions, families, communities, industries, and the media.

A recent study indicates that California may enjoy a stronger regional economy than Texas in part because of its consistent support of higher education research and development and recommends that Texas view investments in colleges and universities as strongly linked to economic development.

APPENDIX III

The purpose of this appendix is to present illustrative exhibits which may be useful to administrators responsible for planning or assessment of state-of-the-art technologies for instruction.

The first two exhibits describe a proprietary report on actual usage of computer-based training (CBT) which the Coordinating Board may wish to consider acquiring and making available for use by its staff as well as by administrators in the field.

The second two exhibits illustrate two different ways of comparing alternative technologies. Exhibit 3 compares some fifteen different "technology-based instructional alternatives" that are highly relevant for a state such as Texas. Although it reflects the unique equipment choices and experience of a particular school district in a different state, the brief paper highlighted by Exhibit 3 illustrates a particular type of assessment that could prove a useful part of the design process to implement the Master Plan for Postsecondary Technical, Vocational, and Adult Education in Texas.

Exhibit 4, on the other hand, highlights a key subset of these technologies, comparing them on the basis of technical properties which have particular significance for "electronic network" delivery system design decisions.

Exhibit 5 presents the front matter of a recent report on the effectiveness and current status of instructional television. Although focused on instruction in four year postsecondary institutions, it contains much that is relevant for planning and assessment of technical, vocational, and adult instructional delivery systems.

The appendix next moves to case materials. Exhibits 6-9 illustrate a number of state of the art approaches which are in keeping with the "teleport" concept of satellite-based interactive instruction which is emphasized in the Master Plan.

Finally, for purposes of contextual overview, Exhibit 10 highlights relevant conclusions of the National Task Force on Educational Technology.

Exhibit 1

A Leading Proprietary Report on CBT Utilization

VOL 4 NO 4 DATA TRAINING MARCH 1985

The Monthly Newspaper For Information Trainers

WHITHER COMPUTER-BASED TRAINING?

In January of 1984 *Data Training* published the results of a computer-based training survey by RSA/Information Designs, Inc., a communications and training firm in New York City. RSA had set out to determine what sort of companies used CBT and what it was primarily used for. It turned out that CBT was most widely used among data processing or technically-oriented training firms, primarily to teach DP skills or the use of software. Hardly anyone used CBT to teach management or professional skills.

In the course of polling 68 *Fortune 500* firms, RSA discovered that 40% of them already offered CBT to their employees. Of the firms who didn't, a hefty 46% planned to introduce it within the year. Terminals connected to mainframe computers were the most common delivery system (51%), followed by microcomputers (38%). Trailing far behind the pack were minicomputers, with 11%.

A year later, RSA conducted the same study, "to monitor whether the trends identified in 1983 would be supported in 1984," according to Rhoda Stern, president of RSA. The new survey asked 102 *Fortune 500* companies about current CBT use, planned use, CBT budgets, courseware, delivery, and authoring systems.

The results were a little different this time. For one thing, microcomputers nudged past mainframe terminals as the primary mode of delivery. Apparently the personal computer has made a permanent inroad as the favored method of delivering computer-based training; the desktop computer is easily available, fairly inexpensive, and very convenient, according to respondents.

The same swing towards personal computers in training was evident in the responses to questions about authoring systems. Last year's survey listed twelve authoring systems, of which four were compatible with the IBM personal computer. This year, 16 of the 20 authoring systems were for microcomputers, and 13 of those were PC-compatible.

According to the 1984 survey, there are now simply more firms using CBT. A solid 62% of the companies participating in the study were using CBT, a 22% leap from 40% in the 1983 study. Why?

Respondents cited several reasons for their media choice. Paramount among them (19%) was the self-pacing capability of computer-based training and the immediate feedback to the user. Next came decreased training costs (17%), convenient scheduling (15%), reduced travel to outside or vendor seminars, standardized training, and faster learning. "The convenience to both trainee and trainer was often added as a reason for using CBT, especially when referring to course scheduling or reduced travel," said Stern.

In 1983's survey, a resounding 88% of the respondents used their CBT to provide training in data processing, technical skills, software application usage, and computer literacy. This year the same subjects accounted for 77% of the training reported, while training in management skills or "product/professional knowledge" trailed along at a meager 6%. There's a growing interest in using CBT for that type of training, though; fully 35% of the firms planned to offer future courses in management and supervisory skills.

Microcomputers, specifically PCs, have made a steady influx into the business world, and the idea of using personal computers as training vehicles also seems to be making steady headway. "CBT continues to rapidly expand as companies capitalize on the proliferation of desktop terminals and as new software and authoring systems reach the marketplace daily," said Stern. "Nevertheless, the use of CBT as an educational experience in business and industry has yet to tap its potential."

Copies of the 1984 report, entitled *The Market for Computer-Based Training (CBT) in Business and Industry— 1984* are available from RSA/Information Designs, Inc., 201 East 17th Street, New York, New York 10003, for $225 each. Copies of the 1983 report are also available for $185.

PP. 8-9

Exhibit 2

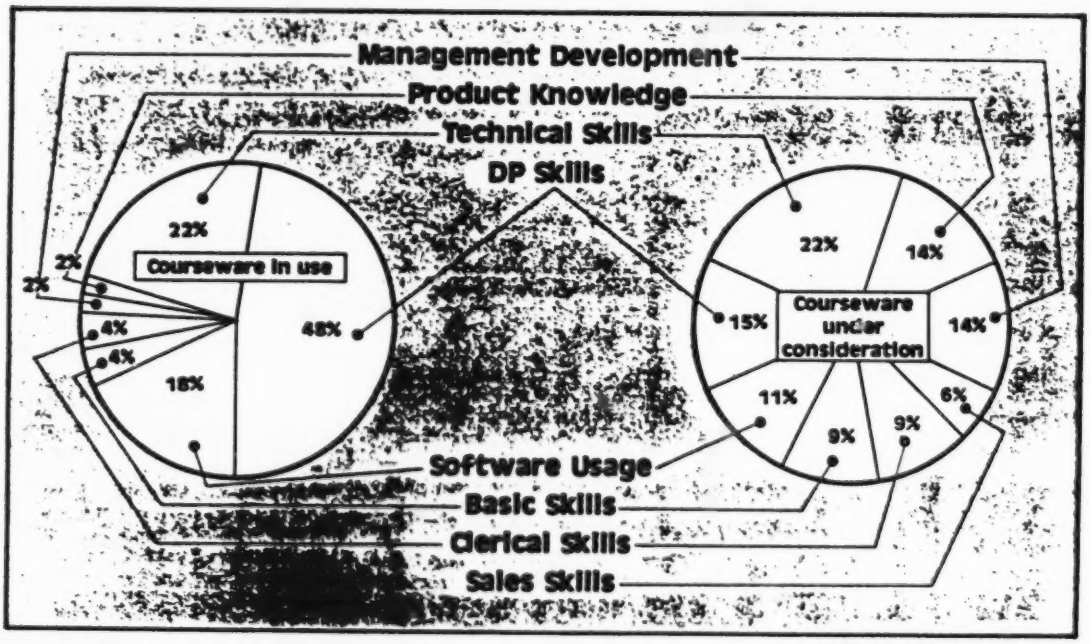
Current and Emerging CBT Utilization

THE NEWSWEEKLY FOR THE COMPUTER COMMUNITY

COMPUTERWORLD

JANUARY 16, 1984 VOL. XVIII, NO. 4

Lower cost, flexibility cited as CBT advantages



Source: RSA Information Designs, Inc.

by Patricia Keefe
CW Staff

NEW YORK — Reduced costs and increased flexibility are the most frequently cited advantages of computer-based training (CBT), according to a survey conducted recently by RSA Information Designs, Inc., a communications and training consulting firm here.

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Exhibit 3

An Illustrative Approach to Assessment

Technology and the Geographically Isolated School District: A Summary of Alternatives

Natalie Krabbe and Ron Cornelius

The Lincoln County School District in Oregon, like many other small districts, is in need of the opportunities technology can provide for its students. The district has five small high schools spread over 1100 square miles. The district's eleven buildings are geographically isolated from each other by hills and rivers and from the rest of the state by a coastal range of mountains. Even though the district provides many services and programs, it is financially unable to provide classes where the enrollment may be only a few students.

To provide a wider range of courses, we decided to investigate a variety of methods and equipment which may provide us with feasible, affordable instructional alternatives. As we sorted and gleaned, we quickly discovered that the majority of systems were used in colleges, businesses, and districts with sufficient funding which could be linked by microwave, cable, or telephone. These issues were instant obstacles because of funding problems and the distribution of our schools. Our schools are served by five cable companies, which are not linked together. One school has no cable service. Another problem is the fact that the schools are served by three telephone companies, none of which are digitalized. The *plus* factors stem from school board interest and support, staff enthusiasm, and student needs. The possible acquisition of a district telephone/communication system and the linking of buildings through the district office mainframe computer were also *plus* factors.

The accompanying chart of instructional alternatives is a compilation of data we have gathered. It is not a comprehensive listing and since technology changes so rapidly some aspects may already be dated, but it should serve as a handy reference point to school districts in situations similar to our own. Note that some alternatives involve Oregon-based resources. Undoubtedly, similar types of programs are now available in other states and regions; thus, the listing here should serve merely as a general guide, not as a specific reference tool for school districts other than our own. □

The authors are with the Instructional Media Center of the Lincoln County School District, Newport, Oregon.

*Technology-Based Instructional Alternatives**

Type	Cost Factors	Equipment	Comments/Concerns
Correspondence courses	Materials Credit cost Text/workbooks		Range of courses available
Videotapes	Initial investment Text Instructor to verify work	Video player Monitor	Limited number of appropriate courses
Computer-assisted instruction	Programs Program development	Computer Disk drive Printer	Available expertise to develop programs

* Applicable to Oregon; some specifics will vary according to state and region.

(Continued)

Exhibit 3 Continued

(Continued)

Type	Cost Factors	Equipment	Comments/Concerns
Teleconferencing One way video-Two way audio Slow scan via telephone lines (35 seconds to transmit full picture) Colorado Video Inc. Box 928 Boulder, CO 80306 303-444-3972	Texts Workbooks Telephone equipment	Camera and TV monitors Telephone Modem	Specialized uses Similar to viewing set of slides
Freeze frame conferencing Pictures, charts, graphs over regular voice-grade lines	Same as above	Camera and TV monitors Telephone Modem	Speaker not visible Visuals are shown
Broadcasting via satellite	Cost of time Equipment	Dishes Uplink and downlink Cameras and TV monitors Transmitting equipment Receiving	Scheduling time Renting/Purchasing equipment
Full motion video/Personal video station Two way video and audio Widcom 1500 East Hamilton Avenue, Suite 2[illegible]7 Campbell, CA 95005 408-377-9981 Other companies with similar products-Pictel, Ovelex, Minx (Multi-media Information Network Exchange) and Vivid (AT&T)		Widcom VTC-56 coder/decoder Desktop console w/ speaker 2 color monitors Telephones	Availability of 56 kb digital phone lines in district Can be transmitted over AT&T Approximately $45 per hr.
Video digitizer Converts video signal into images on Macintosh computers	Equipment Software	Macintosh Mac Private Eye Camera TV monitor Video cassette recorder Mac Paint	Limited use High resolution images
Interactive video systems and/or computer-assisted video instruction videotape/computer disk Self-paced instructional presentation combining computer and video technologies	Planning time Equipment Software	Computer with monitor Videodisc player or Videocassette player Software	Self paced Software will need to be developed Deciding on format and materials
Training programs/development Oregon Partnership Education Program Oregon State University Corvallis, OR 97331 503-754-2179	Staff time to identify needs Cost of partnership Equipment	Computer Video player Monitor	Costly to have developed Will be specific to needs Self-paced

Exhibit 3 Concluded

(Continued)

Type	Cost Factors	Equipment	Comments/Concerns
Simple interactive system Any of the above but with conference call connecting all locations. Pre-packaged materials could be seen at a specific time so that all would be at same place.		Phone Speaker phone	
Videotapes/Text/Instructor University of Oregon Language Program in association with BBC Videotape Language Series (Films, Inc.) French, Italian, Spanish, German, and Russian Ann M. Moore, Ph.D. B.B.C. Program Coordinator Continuation Center 333 Oregon Hall Eugene, OR 97403	Video tapes Texts Workbooks College credit costs Audio cassettes	Video player Monitor Phone available Cassette player	5 languages Translation of college credit to Carnegie units if necessary Guidelines for credit payment WATS line to instructors
TeleBoard Writing data, questions and answers on screen. Viable on any interconnected computer. Todd Stubbs, Technology Director Rocky Mountain Technological Foundation Box 334 Escalante, UT 84726	Specially designed software Licensing Phone line rates	Conference phone 2 Apple IIe 2 modems 2 Apple super serial interface cards 2 Tech-Sketch light pens Optional printer	Origin can vary Teacher visitations possible
Electronic Blackboard Similar to TeleBoard but also uses telephone and hand held microphone. Originally designed by American Bell		Same equipment as above Phone Microphone	Monitor's small size limits amount to be written at one time Foreign languages not as successful because of importance of sound transmission Black and white
Instructional Television Fixed Service (ITFS) Broadcasting from studio via microwave dishes to buildings. This is necessarily two-way communication.	Instructional staffing Technical staff Equipment Licenses Leasing of land Legal advice Planning time	Towers Microwave systems Transmission Test equipment Control room equipment Studio w/cameras Reception equipment	Licensing through FCC Funds need to be on hand Limits of transmission sources/methods: i.e., broadcasting antenna, cable, satellite, microwave One point to many All points to all points One point to another point

Exhibit 4

A Technological Profile for Assessment

	VCR	LVD	CBT	ICAI
Directional flow	one	one	two	two
Interactive	no	no	yes-limited	yes
Common Delivery Sys	limited	v-limited	yes	yes
Information Formats				
Text	no	no	yes	yes
numbers	no	no	yes	yes
graphics	no	no	yes	yes
images	yes	yes	limited	limited
motion (video)	yes	yes	no	no
audio	yes	yes	limited	limited
Random access	no	yes	yes	yes
Devlpmt complexity	low	low	high	high
Relative cost	low	low	medium	high
Ease of Update	low	low	medium	medium
Human acceptance	high	high	medium	TBD
Memory Requirement	low	low	medium	high
Market Availability	high	medium	high	Low

DEFINITIONS

VCR = Video Cassette Recorder
LVD = Laser VideoDisc
CBT = Computer Based Training
ICAI = Intelligent Computer Based Instruction

TBD: To Be Determined

Exhibit 5

A Recent Assessment

INSTRUCTIONAL TELEVISION
A RESEARCH REVIEW AND STATUS REPORT

Prepared for the
Coordinating Board,
Texas College and University System

by

Nil Whittington, Ph.D

Division of Universities and Research
Austin, Texas
July, 1986

EXECUTIVE SUMMARY

In January, 1985, the Coordinating Board, Texas College and University System, adopted rules and regulations to cover the offering of televised instruction by public institutions of higher education. The Board directed the staff to provide research evidence on the educational effectiveness of televised instruction and to report on first-year activities of institutions which had received Board authorization to offer courses via television. This report is a response to these two directives.

The staff reviewed more than 100 published and unpublished documents bearing on the effectiveness of televised instruction. Literature on both pre-produced telecourses and live, interactive televised instruction was examined. The following major findings emerged from the review of literature:

1. Comparative studies indicate that students taking courses via television achieve, in most cases, as well as students taking courses via traditional methods.
2. Findings of equivalent student achievement hold even when rigorous methodological research standards are applied.
3. Television is a technological device for transmitting communication and has no intrinsic effect, for good or ill, on student achievement.
4. Effective instructional design and techniques are the crucial elements in student achievement whether instruction is delivered by television or by traditional means.

5. Recent trends in research are directed toward identifying how best to use the unique capabilities of television to improve education.
6. National producers of telecourses employ procedures designed to create academically acceptable products which will withstand the critical scrutiny of scholars. Academicians are involved throughout the development, production, and evaluation processes.
7. The Annenberg/CPB Project selects proposed telecourses for funding through a peer review process. The courses are subjected to rigorous, continuous formative evaluation by academicians throughout production.

Each institutional application for Board authority to offer televised instruction undergoes stringent review by the staff and the Advisory Committee on Telecommunications and must meet established criteria to warrant a recommendation for approval. Eleven community/junior colleges or systems and four universities have received authorization to offer televised instruction during 1985-86. The staff obtained data from these institutions on enrollments and grade distributions in courses offered via television and in equivalent on-campus classes. Analysis of these data produced the following findings:

1. One hundred thirty-one telecourses were offered in 1985-86 by the community/junior colleges to a total enrollment of 18,996 students.
2. Mean percentage grade distributions are comparable for telecourse students and for students in equivalent on-campus

courses in grade categories A through F.

3. Percentage withdrawal rates for telecourse students are higher; however, in actual numbers, almost four times as many students withdrew from compared on-campus classes as withdrew from telecourses.
4. High attrition rates in community/junior college telecourses may result partially from open admission policies designed to provide educational opportunity to the questionably qualified.
5. Four universities offered a total of 82 courses via live, interactive delivery systems to 889 students in 1985-86.
6. Students took interactive instruction at a total of 44 different receive sites.
7. At the one university with sufficient enrollments for meaningful comparisons, mean percentage grade distributions in televised and concurrent on-campus classes were equivalent in all grade categories, with television students showing higher percentages in the A and B grade categories.
8. Attrition rates in live, interactive televised classes are almost identical to those in on-campus classes taught concurrently and neither rate is excessively high.

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Exhibit 6

Nine Case Studies on Alternative Delivery Systems

DOCUMENT RESUME

ED 271 182 JC 860 397

AUTHOR Zigerell, James, Ed.
TITLE Telelearning Models: Expanding the Community College Community. Nine Case Studies Showing How Colleges, Alone or in Partnerships, Creatively Utilize New Delivery Systems to Reach a Variety of Student Clienteles. AACJC Issues Series No. 3.
INSTITUTION American Association of Community and Junior Colleges, Washington, DC. Instructional Telecommunications Consortium.
REPORT NO ISBN-0-87117-161-9
PUB DATE 86
NOTE 86p.
AVAILABLE FROM American Association of Community and Junior Colleges Publications, 80 South Early St., Alexandria, VA 22304 ($10.00--members; $11.95--nonmembers).
PUB TYPE Reports - Descriptive (141) -- Collected Works - Serials (022)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Audiotape Cassettes; Cable Television; Communications Satellites; Community Colleges; Consortia; *Distance Education; *Educational Radio; *Educational Television; Program Descriptions; *Telecommunications; *Teleconferencing; *Telecourses; Two Year Colleges; Videodisks; Videotape Cassettes

ABSTRACT

Each of the nine articles in this monograph demonstrates the use of a particular telecommunications technology, or a mixture of technologies and media at particular community colleges. Following an introduction by James Zigerell, the monograph presents (1) "Teleconferencing: The Homebound Project at Rio Salado College," by Helen Sprawls, which shows how a telephone in the home or hospital room can offer a direct line between instructor and student; (2) "Audiocassette: A Literature Course from the Bay Area Community College Television Consortium," by George A. Willey, which offers an example of the instructional potential of audio for both direct and supplemental instruction; (3) "Videocassette: Telecourses from the Northern Illinois Learning Resources Cooperative," by Ralph G. Steinke, which explains how a community college consortium offers courses on videocassette in campus learning centers and public libraries; (4) "Videodisc: A Report on Science Laboratory Simulations," by Peter J. Dirr and Victoria Murphey, which discusses a project using videodiscs to simulate science laboratory experiences; (5) "Slide/Tape Modules: Developing Learning Materials in the North Carolina Rural Renaissance Consortium," by Norman Petty, which reports on how a newspaper article was utilized to develop adult learning modules for distance learners; (6) "Educational Access Cable: The Telecommunications System at Kirkwood Community College," by Richard Gross, which describes a model system that combines relatively inexpensive technologies to serve both an urban district and a rural area; (7) "Television: A Computer Course by TVOntario Academy," by David Walker, which shows how broadcasters and educators can work together in extending education and training; (8) "Satellite: The Learning System in British Columbia," by Kathleen Forsythe and Valerie Collins, which demonstrates how a satellite learning system can overcome adult learners' lack of time and problems of distance without sacrificing instructional quality; and (9) "Multimedia: The College of the Air at Mercer County Community College," by George Schwartz, which describes a program employing both broadcast and non-broadcast media to bring educational opportunities to area residents. (BO)

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Exhibit 7

A New Interactive Technology

IBM Introduces

Educational System Product

RYE BROOK, N.Y. – IBM has unveiled an advanced computer-based system—modeled after its successful Writing to Read program—designed to improve the reading skills of adolescents and adults who read below the fifth-grade level.

The new Principle of the Alphabet Literacy System (PALS) was developed by Dr. John Henry Martin, creator of the Writing to Read program for elementary-school children. This phonetic system uses animated video and computer-stored voice as part of a multimedia format to teach the basics of reading.

PALS, which was converted into an interactive video technology by the University of Georgia, combines the use of a licensed program, IBM Personal Computers, video players and the IBM Info-Window Touchscreen display. Students touch an IBM Info-Window videoscreen to operate the controls.

The PALS concept was first tested in 1983 on 23 students from the bottom 10 percent of the class at Cardoza High School in Washington. Reading skills improved an average of three grade levels after students spent 20 weeks of instruction under the PALS pilot program.

In a complete PALS literacy center, up to 16 students can work for one hour sessions under a 20-week instructional program.

The price for a fully configured system with four Info-Window displays, four PC/XTs, four video players, four typewriters and eight PCjrs is $72,000. The package includes four PALS software programs, each with a one-time license charge of $3750. With an educational discount, the cost of equipping a PALS literacy center is less than $60,000.

According to IBM, the PALS system can accommodate 500 students a year. Spreading the cost over a five-year period results in a per-student cost of $50. The new system will be available in the second quarter of 1987 and will be sold through IBM's North Central and South West Marketing divisions.

Source: Computer System News November 3 1986

Exhibit 8

A Simplified Approach

The Design and Application of a Distance Education System Using Teleconferencing and Computer Graphics

Bill Winn, Barry Ellis,
Emma Plattor, Larry Sinkey, Geoffrey Potter

Another Application of Computers

To most people, the use of computers in education means either computer-assisted or computer-managed instruction. This article reports an experiment in another application of computers—the use of computer graphics for the direct instruction of students in distance education courses. Rather than stressing the interactive capability of instructional computer programs, we took advantage of a computer's ability to store and provide instantaneous access to print and graphic material, and to send that material over phone lines to students at remote sites, while leaving the interactive aspect of instruction to instructors teaching over an audio-teleconferencing network.

We believe that the system we have developed to accomplish this has considerable potential for instruction, whether in conjunction with human teachers or, at some future time, coupled with the more familiar CAI and CMI. In this article we describe the system, the instructional roles of the graphics we used, and how we developed two courses which we used to assess the system's effectiveness. Some of the results of that assessment are presented.

System Description

Teleconferencing

The teleconferencing system at the University of Calgary uses the telephone to connect a sound studio on campus, from which the instructor teaches, with up to twenty remote centers throughout the Province of Alberta (for a description of the system, see Ellis and Keenan, 1983). The heart of the system is a piece of equipment known as a "Bridge," a device controlled by a microprocessor through which a signal from the studio is amplified and sent to the centers. It also allows the centers to talk back to the instructor in the studio and to talk to each other. Centers can be connected to work independently of the instructor, allowing the electronic equivalent of "small group activities" in class.

In each center is a "Convener." This device contains a speaker and some switching circuitry. It is connected to the telephone system either directly or by means of an acoustic coupler. Attached to the convener are a convenient number of microphones, which students can speak into at any time simply by pressing a "talk bar." The student is heard by the instructor and in all the other centers. This makes the system fully interactive. As well, the system can be switched to "broadcast" mode, which turns the system over to the instructor exclusively.

Typically, an instructional session will consist of presentations by the instructor, during which students may interrupt and ask questions; discussions and activities within and among centers; and reports about homework assignments completed between classes. The system is not used predominantly for instructor presentations.

NAPLPS/Telidon

The NAPLPS (North American Presentation Level Protocol Syntax) videotex system, like its predecessor, Telidon, around which our system was built, comprises a communications protocol and a decoder for displaying text and graphics in eight colors, eight textures, and eight tones of grey (see Ruggles, Anderson, Blackmore, Lafleur, Rothe and Taerum, 1982, for a fuller description of the system, and O'Brien, Brown, Smirle, Lum, and Kukula, 1982, for a technical description). It is presently gaining acceptance for use in business, industry, government, and the home. Anyone with a decoder and some form of CRT display screen, such as a television set, may access "pages" of text and graphics from a database by means of a keypad or keyboard. Pages can be added to the database at a workstation consisting of a keyboard, digitizer pad, and two CRT displays, one showing the page as it is created, the other displaying menus of commands for page creation, file handling and editing.

Our Telidon software and database were supported by a VAX 1170 computer running UNIX. The software was written in C. It consists of pro-

Bill Winn is at the College of Education, University of Washington, Seattle, Washington. Barry Ellis is at Olds College, Olds, Alberta, Canada. Emma Plattor and Larry Sinkey are at the University of Calgary, Calgary, Alberta, Canada. Geoffrey Potter is at the University of Victoria, Victoria, British Columbia, Canada.

the exception of five students who were not teaching class while the course was being offered, the majority applied the course content consistently. The use profiles varied greatly among the students, as one would expect. However, in the case of forty-four of the fifty students with access to classrooms, an increase in the use of the concepts and techniques taught in the course was observed.

Results from the three questionnaires distributed from September to November showed that students continued to use what they had learned well into the next school year. For September, on average, each student made use of forty-four percent of the content. In October, this increased to sixty percent, and in November it was forty-eight percent. Broken down by frequency of use, it appeared that more content was used "occasionally" than "regularly," while little was used "frequently." However, given the fact that the content of the courses that the students had to teach did not overlap completely with what they had been taught in our course, these results suggest a satisfactorily high rate of use.

In the case of the classroom management course, it was less likely that the techniques and concepts could be applied as immediately. Many of the techniques taught in the course required fairly radical changes in classroom arrangements and procedures, which might be impossible to implement without a change in attitude and sanction by school authorities. It was therefore decided to conduct a more traditional evaluation. Before each session, the thirty-six students filled out a brief questionnaire on which they rated on a five-point scale their degree of familiarity with and the degree to which they used the major concepts and techniques for that particular session. After the session, they filled out another questionnaire, assessing how well they understood the concepts, and how much they thought they would be able to apply the techniques in their classes. The post-session questionnaire also asked questions about the role of computer graphics and the success of the Telidon-teleconference system in that particular session.

When pre- and postsession ratings of students' knowledge of the concepts and techniques taught in each session were compared, statistically significant increases were found ninety percent of the time. In similar comparisons of when students thought they would be able to apply what they had learned, significant increases were found in seventy-four percent of the cases.

The average ratings for the statements concerning the effectiveness of Telidon suggested that after each session the students were very positive towards the computer graphics and to the way they had been used in concert with the other elements of the system. It appeared that our attempts to use the graphics for illustration, showing sequences, structures and spatial relationships were successful.

Answers to this questionnaire also indicated that students took few notes from the computer graphics at the beginning of the course, but took progressively more as the course went on. This suggests that they came to trust the information presented in the graphics as they got used to them. However, other answers told us that, although our system was better than most others they had encountered when taking off-campus courses, it was still not preferred over learning in a traditional classroom from an instructor whom they could see.

Finally, the students really liked the pages that had pictures in them. We frequently used cartoon characters as part of descriptive and illustrative graphics. Apparently, these heightened interest and made it easier for students to understand the ideas and techniques that the graphics described.

Conclusion

Frequently, technological innovations are placed in educational settings and used without the planning, design, assessment, and revision that are necessary if they are to work well. In our project, we emphasized these activities, and it paid off. Our rather thorough evaluation showed that the system succeeded in teaching the students the ideas and techniques we wanted them to know. It did not do this any better, nor any less well, than other systems. But that is not the point. It worked.

Looking more carefully at the particular contribution made by Telidon, we found that the graphics were generally successful in the roles we intended for them—illustration, drawing attention to important material, and explaining spatial and temporal relationships, both literal and metaphorical. Students liked the graphics, thought they were useful, and trusted the information they gave. Information about problems with particular pages was useful to us for making even further revisions to the graphics, but has not been discussed here. Other, more general, guidelines for the design of computer graphics have been presented elsewhere (Winn, Plattor, and Loosmore, 1985).

One final observation. Our system could have been a lot fancier and a lot more expensive. We could have multiplexed the signal or used two phone lines into each center so that we could talk and send graphics simultaneously. We could have placed intelligent terminals in each center so that pages could have been downloaded ahead of class and displayed locally. We could have used "real-time" graphics creation, or two-way video. We

chose not to, believing that it was better to develop a fairly simple and inexpensive system that we could design and test thoroughly rather than to attempt something that might ensnare us in technical difficulties. (Even with our simple system, we had enough of these!) As a result, we believe that our system, or a modified version of it, would be easy to set up in any setting with access to fairly standard facilities like telephones and a computer.

The success of this, or any subsequent project, relies not on sophisticated hardware, but on the skills of the designers, programmers, subject specialists, and instructors. Our experience has shown that these skills are not difficult to acquire, provided that the project is not over-ambitious. □

This project was completed while the first and second authors were at the University of Calgary. It was supported by a grant from the Innovative Projects Fund, administered by the Government of Alberta's Department of Advanced Education. We are grateful for the support and encouragement given to our project by this agency and by many of its employees.

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Exhibit 9

A Rapidly Growing Approach

T · H · E
TECHNOLOGICAL HORIZONS IN EDUCATION
JOURNAL

Vol. 14, No. 3, October 1986

Small District In Texas Utilizes Satellite Network To Solve Large Problem

A classic West Texas town, Moran boasts one grocery store with gas pump, one bank, a post office, a grain co-op, a utilities office, three churches and a population of 335. Moran also boasts a school.

Moran Independent School District encompasses a whopping 325 square miles. But in a part of the country where people are as scarce as the water they drink, it is not surprising to discover that only 78 kindergarten through high school students are enrolled at Moran ISD.

Opportunities to adequately prepare for college would normally not abound for a student like James Green, who plans to attend Humboldt State University in California and major in pre-med.

Many remote, rural schools like Moran ISD have a difficult time attracting teachers. Combined with the nationwide teacher shortage, Moran ISD and similar schools simply find it is not economical to offer courses in calculus or foreign language that only a handful of students like James Green would take.

Texas House Bill #27, which is part of a national wave of school reform, put more pressure on schools with curriculum mandates specifically geared to raise the level of education offered in Texas public schools. Unless a remedy was found, Moran ISD was faced with closing its doors, forcing local students to travel even farther to get to a school.

The solution to this compounded problem had to be economical, since Moran, a ranching and petroleum industry town, had, due to the drop in oil prices, watched its tax base shrivel. In fact, according to Thomas Blackshear, Moran ISD superintendent, the 1986/87 school year tax base is expected to drop 30 percent, from $64 million to $45 million.

Help came in the form of an unexpected medium: the satellite. The TI-IN Network from TI-IN Network, Inc. of Webster, Texas, the district discovered, transmits live, interactive high school instruction and academic resources; its services are available nationwide.

Equipped with a satellite dish in its backyard and a specially designed TI-IN cart—which houses a monitor, VCR, receiver and microprocessor printer, Moran ISD can choose from 25 class offerings slated for the Fall.

James Green can see, hear and talk to his teachers, and he can also interact with his fellow students, who come from all over the nation. His courses are conducted very much like normal classes. An adult volunteer monitors the class, and students are able to take exams and turn in homework just as they do in their non-TI-IN classes.

Says Green, "TI-IN is one of the best things that ever happened to education." This is especially true for school districts like Moran ISD, who, without it, would be forced to close their doors.

TX

TI-IN NETWORK, INC.

COSTS FOR NETWORK SUBSCRIPTION

I. REQUIRED COSTS FOR NETWORK SUBSCRIBERS

TI-IN Network provides a complete turn key service for equipment, installation, maintenance and programming. Certain costs are required to become a Network subscriber and to retain subscriber status year-to-year. Required one-time costs include equipment purchase, equipment installation and talkback telephone line installation. The subscription fee is a required annual recurring cost.

A. Equipment Purchase (One-Time Costs)

3.4 Meter TI-IN Network Ku-Band Receive Antenna With Low Noise Converter (One Per Site)	$2,150
Integrated Audio/Video Unit (One Per Room Equipped)	$2,400

Includes:
- 19" Color Monitor With Function Lights 1/2" VHS Tape Machine
- Dot Matrix Printer
- Equipment Cabinet
- Microcomputer Interface
- Electronic Writing Tablet Interface

The custom-designed equipment cart houses the satellite receiver, signal decoder, talkback base unit and handsets, multifunction interface unit computer and copy distribution equipment, all fully integrated in a lockable cabinet with internal power distribution. The specially modified 19" TV monitor bolts to the cart and all cable interfaces are covered to prevent tampering. Large classrooms or lecture halls may need more than one monitor for student viewing ease, or may warrant 25" monitors or large-screen projection systems. Custom viewing configurations (including required equipment) can be provided by TI-IN.

B. Equipment Installation (One-Time Cost) $3,300

(Each Additional Room Cabled For Program Reception At Same Site At Time of Original Installation is $300)

The TI-IN Network installation charge includes the installation survey and documentation, travel and expenses, equipment shipping and handling, engineering staff time, ground antenna mount, antenna installation and alignment, cable distribution to receive classrooms(s) with line amplifier(s) (when required), telephone interface checkout, integrated classroom audio/video unit installation, and end-to-end operating system check via satellite.

C. Subscription Fee (Annual Recurring Cost)

First Audio/Video Unit in a Building	$4,075
Each Additional Audio/Video Unit in Same Building	$1,340

Includes:
- Network Management and Operations
- Technical Monitoring and Control
- Equipment Lease (Receiver, Descrambler Audio Response Units and Handsets, and Multifunction Interface Unit)
- Maintenance of Leased Equipment

C. Subscription Fee (Annual Recurring Cost) Continued

Maintenance of Purchased Equipment
Insurance for Leased Equipment
Technical Upgrade of Leased Equipment

II. OPTIONAL TI-IN PROGRAM FEES FOR NETWORK SUBSCRIBERS

A subscriber can participate in High School Credit Courses or Staff Development Programs or both. All subscribers receive Student Enrichment Viewing broadcast via the Network at no cost. Pay-by-Participant Programs are received by a subscriber only if registrations are received by TI-IN for an individual program.

A. High School Credit Courses (Recurring Costs)
Per Student Per Semester Class $240

Note: Due To Additional Instructional Support Required Add $50.00 Per Semester For Each Foreign Language and Physics Class Registrant.

B. Staff Development Program (Recurring Cost August -May) 400 Program Hours, Unlimited Participants Per Site

<2000 Average Daily Attendance (ADA)	$2,000
2000 to 12,000 Average Daily Attendance (ADA)	$4,000
>12,000 Average Daily Attendance (ADA)	$8,000

C. Texas Education Agency Programming — No Cost

D. Student Enrichment Viewing — No Cost

E. Pay-by-Participant Programs — Priced by Individual Registrant

III. OTHER COSTS ASSOCIATED WITH A NETWORK SUBSCRIPTION

For each subscriber to efficiently administer TI-IN Network programming, there are several costs not paid directly to TI-IN, which are required for program participation.

A. Telephone Line

A standard business telephone line must be installed into each receive classroom by the subscriber's local phone company. These lines should be dedicated for TI-IN use and should be direct-dial lines (not connected to a switchboard or PBX system) capable of 1-800 toll-free calls without operator intervention. The installation cost varies by phone company, but a typical range is $90 -$125 per line, and is the responsibility of the subscriber. The subscriber is also responsible for the basic monthly charges for each phone line, but since all talkback calls are toll-free, the subscriber does not pay long-distance charges.

B. Administrative Support

There are several ongoing costs incurred by a subscriber that are required to support all program participation. High school credit courses require adult facilitators, return postage for homework and exams, copying of materials sent for class distribution, video tapes and, in some classes such items as workbooks, audio tapes, lab equipment and computer equipment. All programs offered via the Network require the time and attention of a program coordinator and site manager designated to copy and distribute handouts, answer questions, distribute program announcements, troubleshoot technical problems, etc.

Exhibit 10

A Contextual Overview

Special Report

Transforming American Education: Reducing the Risk to the Nation

A Report to the Secretary of Education, United States Department of Education
by The National Task Force on Educational Technology

In the fall of 1984, the National Task Force on Educational Technology was established by Terrel H. Bell, then Secretary of Education, who directed it to investigate the potential of appropriately integrated technology to improve learning in our nation's schools. Noting rapid growth of information technology at all levels of education, the secretary called for a report that would help educational decision-makers sort through the deluge of information (and misinformation) on the usefulness of technology for learning.

From November 1984 through June 1985, the full Task Force met in four sessions of two days each, listening to presentations, grappling with complex and competing ideas, and debating recommendations. From the outset, the Task Force agreed on the following:

Educational technology. The Task Force discussions emphasized electronic, information-age technology, including hardware and software, but did not exclude older, more traditional forms—books, radio and television, audio- and videotapes, and a range of audio/visual technologies.

Scope of the study. The Task Force considered all levels of education, but gave primary attention to elementary and secondary education.

Levels of specificity. The Task Force recommends in general terms, but leaves specific application where it belongs—at the district and school level.

Target audience. The report is intended for educational decision-makers and those who significantly influence them.

The Task Force members agreed to concentrate on the current and emerging needs of learners, not on technology itself. In the course of its work, the Task Force became more deeply convinced that information technology represents a powerful array of tools that when creatively applied and appropriately integrated will help meet three fundamental goals: improving the quality of learning; increasing equity of opportunity, access and quality; and ensuring greater cost effectiveness.

The Task Force used six primary sources of information: descriptions of exemplary programs using educational technology; commissioned papers from experts; letters from professional educators, representatives of professional organizations, private-sector experts and concerned citizens; existing research documents; site visits to schools and technology centers; and public meetings across the country.

Section I: Transforming Education

In 1983, the landmark report ... National Commission ... in Education, ... clearly ... also ... aspects in ... Overall, however, ... is toward better, more exciting and more effective use of technology, as reflected in observations offered in the next section.

Section II: Observations on the Status of Technology In Education

Despite some obvious shortcomings, the presence and use of technology in education has made many converts among educators, parents and students. To a large extent, resistance has been reduced to financial and quality issues, rather than philosophical ones. While educational institutions have made increasingly large investments in educational technology, the technology has often been misused or underused. The negative aspects include:

Lack of Planning. Too often, decisions for purchase and use were made without well-conceived plans to integrate the technology into the overall educational plan. Frequently, the technology was either thrust upon the schools by well-meaning enthusiasts or purchased defensively to ward off real or imagined community pressures. Many individual teachers were supplied with microcomputers without first being convinced about their usefulness or receiving even rudimentary training in their proper application. As a result, the technology was not used as it was originally designed to be.

Inequitable Distribution. Data suggests that information technology is not being distributed equitably. Poor school districts in remote rural areas and some urban neighborhoods lack the means to provide equal access for each student. Although uneven distribution of learning resources is not new to education, the inequitable distribution of educational technology makes the distinction between educational "haves" and "have-nots" even more stark and unjust. In its recommendations, the Task Force addresses this issue most emphatically.

Inadequate Software. Lack of comprehensive planning, inadequate or nonexistent teacher training, and inequitable access march together with several other critical but less important negative items. For instance, early preoccupation with hardware obscured the more essential need to be discriminating and critical about the quality of educational software. Although such software has been designed better in recent years, considerable improvements still need to be made.

Increased Cost. In most cases, educational decision makers consider educational technology to be a sup-

plementary tool; therefore, the costs continue to be incremental. Since the cost of technology usually remains minor in relation to overall school costs, most school districts can temporarily absorb this increment. However, the issue of cost effectiveness will become an increasing problem at first for poorer districts. While technology increases as a percentage of total costs, cost effectiveness will become a problem for all districts.

Obsolescence. Finally, as technology proliferates, educational consumers have become concerned about obsolescence and the lack of compatibility among technologies. Although the information industry functions in the free market, where competition reigns and fosters diversification, the astounding leaps forward in the improvement of products and services and the resulting wide product diversity tend to confuse the educational consumer and user.

There are also several positive aspects to the use of technology. Quite simply, the general concept of technology in education has been accepted, and its presence and use are no longer viewed as an interloper or threat. Very few people still question whether to use technology, but rather debate how much, in what

guage in at least a limited way.

In short, as memory capacity and speed of processing no longer act as constraints, we will have the freedom to present ideas, concepts, techniques, and a richness of information impossible by conventional methods. The Task Force expects this capability to be available within the period of the implementation of the Task Force's recommendations (the next 15 years).

Section IV: Educational Applications of Technology

The Task Force sees five broad uses for technology in education: 1) To develop basic knowledge and skills more efficiently than is possible with conventional instruction; 2) To teach higher-order concepts and reasoning skills that are more difficult to develop without the technology; 3) To develop an understanding of information technology and its uses in society and the workplace; 4) To enable teachers to manage a learning environment in which learning is tailored to fit each student's needs and progress is based upon prescribed levels of achievement; and 5) To develop proficiency in applying computers and related technologies. A discussion of these uses follows.

Basic Knowledge and Skills. Many schools now use computer-assisted drill-and-practice sessions. A number of studies have shown them to be effective, especially in teaching rote skills. For example, one study analyzed 51 separate studies of computer-assisted instruction for high school students. Students who received the instruction performed better on objective tests than students taught by traditional methods, moving them from the 50th to the 67th percentile.

The advantage of such lessons over conventional ones is that they combine the precision and clarity that can be built into the presentation with the computer's incredible patience. More important, the student can set the pace of instruction and receive immediate feedback for each response. The student must participate actively for any learning to take place. The participation, plus the capturing and retention of student attention, are vital to the success of the procedure. For most students, the undivided attention of an automated tutor that is not sitting in judgment but simply providing further knowledge in response to the student's efforts has proven both congenial and motivating.

Higher-Order Skills. People have found it possible to create more effective environments and improved procedures that computer technology makes feasible. Schools should explore and capitalize on technology's potential for expanding educational horizons to include what can be taught through simulation, games, or applications of knowledge-based systems. Computer technology, for example, can be used to simulate a chemistry laboratory. Students can learn and apply the theory behind the combination of various solids, liquids, and gases in a realistic dry run that leaves students and equipment unscathed even when results are explosive!

Understanding the Technology. In an information society, the schools must give students an understanding of the technologies that are shaping their lives and creating new patterns of job opportunity. In this use, information technology becomes the object of study as well as a tool for learning. Students learn the history of computer-related technologies and their impact on society.

Furthermore, courses in this field will show students the impact that computers are having on the working world they will be entering. Databases can be used to estimate which fields of employment will grow through the end of the century and which ones will diminish. The impact of information technology on politics, entertainment, commerce, international trade, diplomacy, and other areas will be studied. Schools should integrate this information into all subject-matter areas rather than create a new course.

Instructional Management. For the student, technology-based education promises to help fit learning to his or her individual needs. For the teacher, it promises to keep track of the rapidly multiplying complexity of records that such learning requires. A classroom in which different individuals and groups move in their own patterns and at their own paces requires a good deal more monitoring and adjusting than one based on common assignments in which all students are expected to take the next step at the same time.

The computer's ability to manage large amounts of information quickly and logically offers the teacher a tool to keep track of varying rates of progress and individual problems without being overwhelmed by recordkeeping demands. By removing these administrative tasks from the teacher's role, the technology frees the teacher to give more attention to the needs of each student. The conservation of teacher time gained through greater efficiency in managing individualized learning will be offset somewhat by the added demands of managing a more complex program. But it seems fairly clear that the learning gain from this trade-off will be large.

Applying the Technology. Schools need to teach students the skills that are fast becoming passports to better-paying jobs. These skills include word processing techniques, calculating routines, alternative ways of transmitting data, and the use of electronic mail and electronic bulletin boards.

Section V: Effects on Education

The accumulation of evidence of the effectiveness of technology in education has been [illegible] limited

...the-
...ject-matter
...dent using tech-
...education promises to
...the transformed learning
...ronment that will ultimately
provide the excellence we seek.

Section VII: Recommendations

1) Planning. The effective use of technology in education requires careful planning at every level of the educational system. The needs of our rapidly changing society cannot be met, nor can available resources be optimally employed, if technology is allowed to percolate randomly through the school system. It is not intended that the technology be allowed to determine educational goals, but must be used to help achieve them.

The Task Force recommends that every educational decision-making group participate in ongoing planning for the incorporation of technology into the educational system to serve its purposes effectively. Technology planning needs to be integrated with other aspects of planning, and include all appropriate areas—particularly financing, teacher education, curriculum and instructional practice, evaluation, and dissemination.

To actually implement strategies, schools should:

- Begin to plan for the management of the computer-managed learning environment, that will use all forms of technology, and will allow students to progress at varying speeds according to their individual abilities.
- Plan for the orderly acquisition of both the hardware and software needed to serve the school's educational goals.

School districts should:

- Plan to include as line items in the regular school budget all the costs of employing technology—the acquisition of hardware and software, maintenance and replacement, and the education of teachers and other school personnel in its use.
- Develop strategic plans for educational improvement that recognize the needs of a changing society and that provide for continuous planning that anticipates change. Plans should include the development of a district office of technology to help teachers and school administrators implement the strategic plan. A central facility should be established to serve as the hub of a local area network to be implemented once the technology makes it feasible.
- Involve parents in the planning process from the outset.

School boards should:

- Set policies for planning at the district and school levels to ensure that decisions to purchase and use technology are made within the context of overall school improvement strategies.

State education agencies should:

- Ensure that local plans and their implementation provide equity of access to educational technology.
- Encourage and support local planning and implementation efforts. The support should include funds and technical assistance to help schools plan. These agencies should recognize the developing need for technology-based education and reward good planning at the district level with financial support, including seed money for well-planned development efforts.

Education should begin planning now (and be prepared to update plans to account for future developments) for completing the transition to the full utilization of educational technology during the 1990s. Such planning needs to account for the flexible education system required for mastery of subject matter that will be centered in the schools but also incorporate the home and workplace as educational settings. Plans for the school of the future include the design of physical space appropriate to technology-based education, provision of databases and the resource of computer-assisted lessons in all subject areas that are accessible to student workstations in school and at home, and access to national databases where needed.

2) Financing. The T...
believes that educat...
more cost-effe...
enhanced ...
edu...

APPENDIX IV.

Significant Sources of Unpublished Information On the Future of the Workplace in Texas

Not surprisingly, much of the most relevant information regarding employment-creating development in different regions of the state does not exist in published form--either because it is too new, or because it is somewhat politically sensitive.

For this reason, a brief telephone survey was conducted in order to identify significant activities and knowledgeable informants regarding new sources of employment and their implications for technical, vocational and adult education. The purpose of the survey was not to exhaustively catalog such activities and informants, but rather to "scout the terrain" in order gauge "the state of the state" and to identify the what types of additional studies and planning activities may be needed in order to effectively implement the Master Plan for Postsecondary Technical, Vocational, and Adult Education.

This appendix presents the principal results of this brief survey in three categories:

1. The organizations which were reported to be most involved in creating "leadership visions" of the future;

2. Persons who are knowledgeable about the activities and outlook of that organization--including both those who served as informants to the project team and those who were recommended as good contacts;

3. Written reports or other materials which either are, or may be becoming available.

Significant Organizations	Knowledgeable Persons	Written Materials
For the State as a Whole		
Texas Business Development and Jobs Creation Task Force	Miles Edelman	Subcommittees now reporting out; Task Force report to follow in a few months
Texas Science and Technology Committee	Meg Wilson	A report, "Texas Strategies for Economic Development" soon to be released
Texas State Occupational Information Coordinating Council	Rich Frochelle	State Plan for Labor Market Information System Development (March, 1986)
Venture Capital Task Force	Meg Wilson	
Gulf Coast Region		
Houston Chamber of Commerce	Charles Savino	
Houston Economic Development Council	Eileen Crowley	
Clear Lake Area Economic Development Foundation	Stephen Sandstedt	
The Border Region		
Border Economic Development Task Force	Ruben Garcia	Border Economic Development: Final Report and REcommendations

The Plains Region

West Texas Chamber of Commerce	Adolph Yanca
Midwestern State University	Mike Lawso

East Texas Region

East Texas Chamber of Commerce	David Ross
Technology Partnership Organization	W. A. Mayfield

The Metroplex Region

North Texas Commission	Harden Wiedemann
North Central Texas Council of Governments	Bill Pitstick
Dallas Partnership (Dallas Chamber of Commerce)	Wayne Boling
Fort Worth Corporation (Fort Worth Chamber of Commerce)	Wayne Sterling

Central Corridor Region

Austin Chamber of Commerce	Lee Cook
Bryan-College Station Chamber of Commerce	Len Stuart
Bryan Forward (to the year 2000)	
College Station 2000	

City of San Antonio, Department of Economic and Employment Development	Frances Gonzales
San Antonio Economic Development Foundation	Stephanie Coleman